ALFREDO RUGGERI, *gerente responsabile*.

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FIRST PART.

ORIGINAL ARTICLES

he Selection and Hybridisation of American Vines in Italy

by

Dr. G. Patanè

Ministry of Agriculture, Italy.

Historical.

The replanting with resistant vines or reconstitution of the vine-rds destroyed by phylloxera, was begun in Italy more than thirty years o. For this purpose seeds of American and French vines were im-rted, and from these plants were obtained, of which only the strongest d those which retained intact the characteristics of their species were eserved. At the same time the work of hybridisation between these nts and the native vines was started, but, since it was necessary to bmit the plants produced to long trials, they were not introduced at once to general cultivation. However, definite conclusions as regards many of ese hybrids produced in Italy and especially in Sicily cannot yet be giv-, for their cultural value has not yet been tested in a sufficient number localities or in sufficiently diverse conditions. On the contrary, for her hybrids experimental trials are already numerous and it is possible state that they possess valuable qualities as regards resistance to phyl-xera and to drought, adaptability to different soil conditions, and inity for the native vines.

At the beginning of the work of reconstitution all the facts of this portant problem were not known. The vine-growers were accustomed see the European vine prosper in almost all soils and the most diverse nditions, and believed that the American vines would do so; they forgot at the innumerable varieties of the former belonged to one species (*Vitis nifera*), while the latter group was composed of various species adapted, roughout centuries, to live only in special conditions. As a result fail-

ures in the culture of the American vines were of frequent occurrence; either the vine chosen as stock (graft-bearer) was not adapted to the nature of the soil, or the grafting rarely took successfully, or else the vine showed hut little affinity for the native plants chosen as scions. This explains the fact that certain vines, such as York Madeira, which gave rise to much enthusiasm at first, disappeared rapidly from the reconstituted vineyards; that others, such as Clinton and Jacquez, commended as direct bearers of good grapes, have suffered the same fate or have remained only in limited areas, and finally that certain excellent vines, such as Riparia, which is cultivated in all districts, do not always give the results expected from them.

Failures of this kind, however, have been experienced in other countries ravaged by the pest of phylloxera; in Frante, for example, where in the early years of reconstruction the vines Taylor, Concord, Clinton, York Madeira; Jacquez, etc. were widely planted, though but few examples of these vines are found there today.

France, which had preceded Italy in the work of reconstitution, had in the meantime selected certain American vines and had produced some new hybrids which, tested in the vine-growing regions, had given good results. The Italian vine-growers, discouraged by their failures with plants grown from seed, had recourse to the vines produced in France, and began to import them. These vines were derived partly from the selection of pure species (Riparia Gloire and Grand glabre-Rupestris Martin, Ganzin, and Metalique-Berlandieri Resseguier Nos. 1 & 2) and partly from hybrids. The latter group had been obtained by crossing American vines partly among themselves (Riparia × Rupestris Coudere 3306 and 3309 etc.) and partly with French vines (Aramon × Rupestris Ganzin No. 1 — Mourvedre × Rupestris 1202 — Chasselas × Berlandieri 41 B., etc.).

In addition to these plants destined to serve as stocks, the French vine-growers endeavoured to obtain hybrids which would act as direct-bearers, and many of such hybrids obtained by CONDERC, SEIBEL, CASTEL, etc., were introduced into Italy. These plants, however, did not generally give the results which were expected from them, and were not widely cultivated.

The Italian Ministry of Agriculture greatly encouraged the distribution of the French stocks, but the work of selection and hybridisation was regarded as superfluous and its cessation was ordered in the institutions under government control. Reconstitution by means of French stocks alone was encouraged; these were distributed everywhere but were not always chosen with sufficient care. As a result the excellent work of GRIMALDI, RUGGERI, PAULSEN, LONGO and others who believed in reconstitution with American-Italian plants was neglected and sometimes interrupted.

In practice this new departure in the work of reconstitution did not always give the results which were expected, and numerous and serious failures occurred especially in districts with a dry climate, so different from those in which the new vines had been developed and selected. These

llures are easily explained by the phenomenon so well described by of. ORAZIO COMES, director of the College of Agriculture at Portici: A plant cultivated in a climate different from that of its native country eserves, and may even increase, its original resistance to injurious conions if it has been transplanted to a colder climate"; on the contrary gradually loses this resistance in proportion to increased warmth in the imate. (1)

It is undoubtedly easier and more expeditious to introduce into a untry plants which have already been tested elsewhere, than to select e native plants, but the results are often less satisfactory. D. FREDco PAULSEN (2), director of the American Vine Nursery at Palermo, as stated, during the course of a vigorous and impartial enquiry in the ineyards of Sicily, that the American vines with which many vineyards ave been replanted are often *less productive* than native vines planted in lentical conditions, and that the reconstituted vineyards *do not last as long* s the old vineyards of *Vinifera* planted as a selfbearer. On the contrary l France the new plants produce abundantly; it is not unusual to obin 1800, 2200 even 2700 gallons of wine per acre especially in the south ith the vine Aramon. It is evident, Dr. Paulsen states, that the lesser roduction obtained in Italy is contrary to the facts observed in France here reconstitution was first started, and where the serious problems hich it entails have been largely studied.

The Italian Ministry of Agriculture was naturally troubled at the ay of the vineyards replanted with stocks imported from France and 1914 it was decided to revert to the previous methods. The institus under government control were ordered to undertake experimental rk with the object of producing indigenous stocks, which would be more ited to local conditions and would possess more affinity for grafting with e local vines. The directors of the schools of vine-growing and vineking, of the agricultural colleges, of the American vine nurseries, as ll as the technical experts at the head of the anti-phylloxera associans ("Consorzi antifillosserici") welcomed with enthusiasm this new ise, the adoption of which had been previously urged in vain by many them. The work is now carried on with much activity in the above ned institutions, in fact in some of them it had never been interrupted. s the greater part of this new work has only just started, results can only e given by those institutions, or individuals, who had undertaken the ork in the earlier period and had never entirely relinquished it. The lection of vines has in some cases been carried on for several years for e experiments with them were still conducted in spite of the regulations the contrary which were in force for some time. It is possible to state

(1) Prof. O. COMES, **La Profilassi, nella patologia vegetale.** *Reale Istituto d'incoraggiamento di Napoli*, pp, 19 **Naples, Cooperativa tipografica.** See also *B.* August 1916, No. 937.

(2) Dr. F. PAULSEN, **Risultati della ricostituzione in Sicilia. Ammaestramenti del passato e consigli per l'avvenire. Relazione presentata al Congresso dei viticultori siciliani** riunitosi a Noto il 24 **agosto 1914. Palermo, Tipografia G. Di Giorgi, 1914.**

briefly the chief results obtained by the government institutions, by the anti-phylloxera associations, and also by certain vine-growers, interested in their occupation, who have succeeded at considerable expense and thanks to indefatigable labour in producing vines of considerable value.

In giving the following results it is convenient to group them according to the nature of the institutions in which the work has been carried out, thus — agricultural colleges, government nurseries for American vines, anti-phylloxera associations, private vineyards.

Work carried out by agricultural colleges and schools.

1) *Alba (Piedmont), School of Vine-growing and Wine-making.* — This school, which is now directed by Prof. F. A. Sannino, took up the work of hybridisation between American vines and those of Piedmont at the time when the late Prof. Domizio Cavazza was at its head.

A hybrid Barbera × Rupestris Cavazza N° 1, of which the female parent occurs in the garden of the castle of Barbaresco, appears to be doing well and promises to give good results in the future; in the experimental vineyard of Vallecrosia it lasted from 1889 to 1907 in which year the vineyard was suppressed. On the estate known as *Bricco*, which belongs to the Cavazza family, it has been cultivated partly as a self-bearer and partly by grafting. It is hoped that it will form a good stock for the region of Piedmont and especially for the vine Barbera.

Among other hybrids obtained by Cavazza, the following may be mentioned;

Barbera × Rupestris; still in the experimental stage.

A hybrid of Berlandieri (from seed) obtained in 1888.

Another special hybrid of Berlandieri.

Solonis × Nebbiolo Cavazza No. 11.

Barbera × Rupestris Cavazza No. 2, of which the plants bearing the numbers 22, 26, 28, are the earliest and most prolific; they have a pale green foliage which recalls that of Gamay Couderc.

Barbera × Rupestris Cavazza No. 3.

Barbera × Rupestris Cavazza No. 4, which is somewhat susceptible to mildew.

Some hybrids Dolcetto × Rupestris bearing the numbers 5, 6, 7, 9.

Dolcetto × Jacquez No. 10, prolific, fairly resistant to mildew and oidium.

2) *Avellino (Campania), School of Vine-growing and Wine-making.* — At this School, under the directorship of Prof. Giulio Paris, Riparia, Rupestris, and Berlandieri plants have been obtained from American seed but the Riparia plants have been specially selected as more adapted to the deep, light, and moist, volcanic soils of the region of Avellino and of a large portion of Campania. The selected Riparia have large entire leaves; these are glabrous on both surfaces, shining and slightly crinkled; they recall the types Gloires and Grand glabre. Some types obtained at Avellino are somewhat superior to the French types as regards vigour and

eauty of foliage. Their resistance has been the subject of experimental sts at Macomer in Sardinia. In 1890 the best plants of selected Riparia ere crossed with Rupestris derived from seed; crosses were also begun etween Rupestris and foreign vines (Malbec, Sirah, Cabernet, Pinot, iuscat violet etc.). In 1893 Italian-American hybrids of Sangiove, Malisie de Toscane, Aglianico, Sciascinoso, Aleatico, with Rupestris were btained.

Finally in 1903 and 1904 vines selected in France were brought from the remiti Islands and hybridisation with American vines was given up. n the other hand crosses of various European vines among themselves ere started with the object of obtaining better grapes, and among other ybrids the following were produced:

Trebbiano	×	Riesling du Rhin
Trebbiano	×	Pinot blanc
Trebbiano	×	Traminer blanc
Malvoisie	×	Sauvignon
Malvoisie	×	Riesling
Aglianico	×	Merlot
Aglianico	×	Cabernet
Aglianico	×	Pinot

3) *Cagliari* (*Sardinia*) *and Catania* (*Sicily*), *Schools of Vine-growing and Wine-making. Florence* (*Tuscany*) *School of Horticulture and Fruit-growing.* — From seeds imported from America some good types have been produced, which have given satisfactory results in those districts where they were obtained.

4) *Conegliano* (*Venezia*), *School of Vine-growing and Wine-making.* — From seedlings of Riparia, a Riparia tomentosa was selected which was extensively cultivated in the district of Conegliano; it gave such good results that some vineyards grafted on this plant are still found in full production after thirty years.

This type as well as other excellent types obtained from seed were ven up when vine plants selected in France were imported. At the same me selections from cuttings of American and European vines were tried, id the method proposed by RAVAZ was employed as the basis of selection . *e.* the starch content of the cutting is determined by the iodine reacon) but these experiments were interrupted by changes in the staff of the chool.

Twenty years ago some hybrids of Cinerea × Pagadebito were obtained; these were not devoid of interest but the experiment was not followd up.

DALMASSO, professor of vine-growing and wine-making, has at the present time extended the observations and researches on the adaption and affinity of the principal American stocks, and has taken up the work of hybridisation and selection conducting the latter according to the method proposed by RAVAZ.

5) *Grumello del Monte* (*Lombardy*), *School of Practical Agriculture.* — Some good types have been obtained from vines grown from seed, and

among these a Riparia glabre with large hardy leaves similar to those of Grand glabre may be noted; it is a suitable plant for the reconstitution of the vine-yards in some districts of the province of Bergamo.

Work carried out by the government nurseries for American vines.

1) *Nursery at Acqui* (*Piedmont*). -- This nursery was only established in 1910 and has not yet produced plants which have been sufficiently tested. Three numbers of Berlandieri × Riparia obtained at Asti from seed of Berlandieri Resseguier No. 1 from France, have been selected. Some Italian-American hybrids obtained in the Asti Nursery have been planted permanently and kept under observation; these were as follows:

Lambrusca	×	Ruspestris du Lot
Lambrusca	×	Berlandieri
Grignolino	×	Berlandieri
Lambrusca	×	Berlandieri-Riparia 157-11
Freisa	×	Rupestris du Lot
Barbera	×	Rupestris metallica
Cortese	×	Rupestris du Lot
Cortese	×	Rupestris-Berlandieri 301 B.

These hybrids have up to the present remained exempt from phylloxera.

2) *Nursery at Asti* (*Piedmont*). -- This nursery is no longer under government control and has been annexed by the anti-phylloxera association of the district. Selections of Riparia and Rupestris and of some other species have been made but the results are of little value.

Hybridisations were also carried out but they have not been continued (See the above paragraph).

3) *Nurseries at Cagliari and at Macomer* (*Sardinia*). — For fifteen years these nurseries have cultivated some numbers of Riparia, of Rupestris, and of Berlandieri obtained from seed in the following institutions: School of Vine-growing and Wine-making of Avellino — School of Horticulture and Fruit-growing at Florence — Nurseries at Velletri and at Barletta; but these trials conducted in a single locality and in restricted areas are not yet conclusive. It is possible to state, however, that the plants are growing well and promise to be valuable.

4) *Nursery of Noto* (*Sicily*). — The director, Dr. C. Montoner has obtained two varieties of Rupestris: — Rupestris Noto No. 2, an Rupestris Noto No. 23, which are resistant to phylloxera, to drought an to large amounts of lime in the soil; they do well when used as cutting and as grafts and have a marked affinity for the native vines, to which the give remarkable fertility. Prof. Di Mattei, in his report to the Congress Noto in August 1914, advised the use of these two Rupestris in the plac of Rupestris du Lot which is very liable to " bramble-leaf " (roncet), an predisposes the vine to abortion of the flowers.

Rupestris Montoneri No. 1 and No. 2, which are also cultivated, ar both extremely promising.

Numerous experiments in hybridisation have been made but definite sults with regard to the hybrids obtained cannot yet be given.

5) *Nursery of Palermo* (*Sicily*). — The Director, Dr. FEDERICO PAULSEN, has obtained several thousands of hybrids and has carefully selected hem after several years of cultivation. As Dr. PAULSEN himself observes, is difficult to find a stock which is able to offer identical advantages in ie various conditions of cultivation, and these hybrids have therefore been sted in the experimented vineyards of the nursery and in those of priate vine-growers. In some cases plots were planted with free stocks rafted on the spot, and similar plots with stocks grafted elswhere, and hen permanently planted.

Of the hybrids bearing the numbers 1 to 1450, those which have given he best results in the first trial as regards resistance to phylloxera, luxuiance of vegetation and affinity for the local vines Inzolia and Pericone are:

Mollacchina	×	Rupestris 401
Perricone	×	Rupestris 417
Berlandieri Catania	×	Catarratto 737
Berlandieri Catania	×	Riparia 810
Catarratto	×	Rupestris Ganzin 877
Mollacchia	×	Rupestris 403
Berlandieri 2	×	Rupestris Monticola 782
Ciminnita	×	1202, bearing the number 1056
Catarratto	×	Rupestris du Lot 1072
Catarratto	×	Rupestris du Lot 1074
Berlandieri	×	Rupestris du Lot 1163
Jacquez	×	1202, bearing the number 1256
Berlandieri 1	×	Aramon-Rupestris 1330
Berlandieri 1	×	Rupestris Martin 1341

It was found as the result of numerous observations made under vaous conditions that a different stock was required for each kind of soil and lten for each kind of scion. Dr. PAULSEN states in this connection that ie difference in adaptive qualities between the various stocks become more vident as the conditions of reconstitution become more difficult. In the uthern districts, where the two main factors which hinder replanting ith American vines are drought and the intensity of the phylloxera pest, he choice of stocks should be made with special care, and should be suitd to the frequent changes in the nature of the soil and in the climatic onditions.

At the present time among the thousands of hybrids produced and exensively tested by Dr. PAULSEN the following numbers may be recomiended:

P. 1043 (Berliandieri × Aramon Rupestrs) and P. 1341 (Berlandieri × Rupestris Martin) are very suitable for light, sandy calcareous soils ith a tufaceous and strongly calcareous sub-soil. In the experimental ineyard of Casa Bianca (Marsala) Number 1043, though it grows but moderately as a free stock, bears vigorous scions which make a throughly ood growth even in the driest years. Number 1341 has always retained its

fine vegetation and the scions have always given a good and constant production.

P. 779 (Catarratto × Berlandieri) is very suitable for light sandy or calcareous soils and continues to do well in the experimental vineyard of Casa Bianca. It has given the most satisfactory results on deep loam soils which are not too dry (experimental vineyard of Spadafora) ; in such conditions it grows freely and bears productive scions.

P. 1548 (Berlandieri × Aramon Rupestris) has a normal development and a normal and constant productivity on deep loam soils which are very compact (experimental vineyard of Roccazzo). In the experimental vineyard of Mazara on a light, calcareous soil with a compact and strongly calcareous sub-soil this number shows a fine vegetative growth after three years both as a free stock and as a graft.

1742 (Berlandieri × Rupestris du Lot) and P. 1902 (Catarratto × Rupestris du Lot) are well adapted to deep, compact, loams, like those of Roccazzo, where they have done well for several years.

Riparia × Rupestris N° 2 A, selection P, has been derived from the selection of plants obtained from seeds of Rupestris. It is easily propagated by cuttings, develops rapidly and gives a luxuriant vegetative growth.

It grafts successfully and produces fruitful plants. It is specially suitable to medium loams which are not very compact but fairly deep and moist.

6) *Nursery at Palmi and at Nicastro* (*Calabria*). — The reproduction of some Riparia plants from seed and the formation of Calabrian-American hybrids has been started, but it is not yet possible to give the result of the work.

7) *Experimental vineyard of Spadafora* (*Sicily*). — At Syracuse the late Prof. ANTONIO RUGGERI, with the assistance of Cavaliere BENIAMINO ANTOCI, began to select American vines grown from seed, especially plants of Berlandieri : he also began to cross Berlandieri, and Rupestris du Lot with some of the most popular local vines. When transferred to Milazzo, he took with him young plants produced at Syracuse and continued and extended the work of hybridisation. As the nature of the soil of the nursery at Milazzo did not allow him to undertake conclusive trials, he established an experimental vineyard at Spadafora. Here he brought to a successful termination some experimental trials worthy of mention, both with vines due to his own efforts and with those produced by GRIMALDI and PAULSEN as well as with some types of Berlandieri selected at Barletta. Trials were also carried out in private vineyards on various types of soil infested with phylloxera ; the soil was in some cases clayey and compact, in others of medium consistancy and fertile, or again light and poor. It is, in consequence, possible to bring together observations which indicate that certain vines tested over long periods, are suitable for introduction into general cultivation. The introduction of such vines is of special importance, as the decay of the vineyards reconstituted with stocks from beyond the Alps has shown the necessity of reconstitution

h indigenous vines which are more suitable to the soil and climatic condi-
ıs of Italy.

Out of Sicily the hybrids due to RUGGERI have been grown with ex-
ent results in Apulia, in Calabria and in other countries than Italy. At
International Congress of Agriculture at Madrid (1911), M GARCIA DE
SALMONES recommended from his personal experience twelve num-
; of this hybrid for cultivation on dry calcareous soils. A collection of
se hybrids has been sent to Algeria at the request of Prof. MARÈS who
ascertained their success in Sicily.

Among the numerous hybrids produced by RUGGERI the following
, be noted :

130 (Berlandieri × Rupestris). — This hybrid is adapted to various
es of soils, including soils light in colour and thoroughly calcareous in
:acter on which it has given good results.

42 (Berlandieri × Rupestris du Lot). This hybrid does well over
airly extensive area. It grows freely on moist marls even on those
in lime (50 to 60 per cent Ca Co3). It is not always as resistant as 140
cannot be recommended for clay soils on which it develops but mode-
ly.

199, 225, 267 (Berlandieri × Riparia). These vigorous hybrids
ıtain the productivity of the scion at a high level and are suitable for
vation over a fairly extensive area, especially 199 and 225. The last
ber, 267, prefers the same soils as Riparia and on them it surpasses the
species, but it is also successful on soils of poorer quality. Although
rous 199 and 225 are not equal to 267 on soils which are suitable for the
r but they are more resistant to drought and will tolerate larger amounts
ne in the soil.

19 (Albanello × Berlandieri). The resistance to phylloxera of this
id is very great : after 10 years of cultivation its roots are in as good
ition as those of the most resistant pure species. It has a marked
ty for the native vines and as it is tolerant of drought and of a large
unt of lime, it does well over a fairly extensive area. The production
ants grafted on this stock is regular and constant.

3) *Nursery of the Tremiti Islands (Adriatic)* (1). — No selections of
s grown from seed have been made but hybrids have been produced
een American vines (Rupestris and Berlandieri) and numerous Ita-
vines (Trebbiano, Sangiovese, Malvoisie, Moscatello, etc). Some of
hybrids have already been tested in different provinces of Italy espe-
in Apulia. The tests, however, have not yet been carried out for a
iently long period to justify statements on these hybrids. Hybrids
een various American vines have also been obtained but they are not
ether satisfactory, especially in regard to their adaptive qualities.

)) *Nursery at Velletri (Rome)*. — The Director Professor ANGELO
O has selected 40 numbers of Riparia and 11 of Rupestris grown
seed. These vines have been distributed in various districts espe-

) See *B.* 1914, No. 246.

cially in Tuscany, in Apulia, in Sicily and in Sardinia. In many cases th results have been satisfactory, both as regards resistance to phylloxer and drought, and as regards vigour of growth and productivity. This however, has not always been the case. For example in Tuscany, in th valley of the Arno and on the plains of Prato and Pistoia, where quater nary soils occur, these vines have given excellent results: on the othe hand they have given less satisfactory ones in the following districts: i Chianti and in the valley of the Sieve where gravels intercalated in th calcareous "alberesi" of the Eocene are abundant: on the hillsides of th Upper Valdarno and of the valley of Greve, where marly calcareous soil and cretaceous gravels occur: in the valleys of Elsa and Pisa where clayey marls alternate with the conglomerates, gravels and sands of the Oligocene In Apulia and Sicily and in Sardinia the results have in the same way beer excellent in some regions and poor in others. At Marsala, for example on soils with as much as 85 % per cent of lime, the director of the local anti-phylloxera association considers that the results have been satisfactory

Work of the Anti-Phylloxera Associations.

These associations were instituted with the object of protecting vin growing against the attacks of phylloxera. They were first formed: Apulia and later in all Italian districts where such action was necessar and aim, by the introduction of America vines, to reconstitute the vin yards destroyed by this terrible pest. The associations, directed by techn cal experts, have also undertaken experimental work in selection an hybridisation, with the object of obtaining stocks suitable to the district in which they are to be cultivated. The initial work of these experiment was undertaken by the late Prof. Neoraldo Danesi, general inspector o agricultural industries, assisted by the technical representatives of th anti-phylloxera societies and especially Dr. Armando Mignone as well by the director of the Experimental Nursery of the Tremiti Islands.

Numerous crossings were made between the local vines, of which the be as regards hardiness and longevity were chosen, and such American vin as lent themselves to the process: (Rupestris Martin and Rupestris Met lica Berlandieri and its hybrids Riparia and Rupestris). Attempts we also made to cross certain American vines among themselves, such a Rupestris Ganzin, Rupestris Martin, Rupestris Gaillard, Rupestris d Lot, Cordifolia typique and Cordifolia Davin, Aestivalis, Berlandie all calcicole (lime-loving) vines. Definite results have not yet be obtained but it can already be foreseen that the societies, in fo lowing up the work in which they are engaged, will be able shortly to pr vide for each district stocks and possibly direct bearers thoroughly acc matised and very resistant to phylloxera. It is expected that these plan will show adaptive qualities, possess a strong affnity for the local vine and will be capable of giving better results in practical cultivation tha the vines commouly employed to-day.

To test the hybrids obtained by Danesi and by the staff of the anti

ylloxera associations, *two fields for experiments on the resistance of American vines to phylloxera were instituted in Apulia.* These fields are in the strict of Cassano Murge and of San Michele which in Apulia were among e first to be attacked by the destructive insect. Hybrids obtained by valiere BENIAMINO ANTOCI in the Tremiti Islands, are also studied in ese experimental fields.

In addition to resistance to phylloxera, the composition of the grapes the direct bearers is being studied : this task was entrusted by DANESI the School of Olive-growing and Oil-making at Bari.

The experiments made at Marsala by Cavaliere GIUSEPPE VAIARELLO, rector of the Anti-phylloxera Society of that locality, are also of suffient interest to be mentioned. In the nurseries of the association the cilian-American hybrids of PAULSEN and GRIMALDI and RUGGERI have en tested. The numbers 88, 110 and 317 of GRIMALDI, the numbers 110, 8, 140 and 298 of RUGGERI, and the numbers 779, 1120, 1381, 1548, 42 and 2A of PAULSEN are specially worthy of consideration. A hybrid ich is also expected to do well is Calabrese × Aramon-Rupestris 953, direct bearer obtained by GRIMALDI.

M. VAIARELLO has also undertaken work on hybridisation, but it uld be premature to pronounce judgment on the results obtained.

WORK CARRIED OUT BY PRIVATE VINE-GROWERS.

Some private nurserymen have selected American vines grown from d, and some of the vines placed by them on the market have given rly good results in the districts in which they were obtained. How-r as regards continued and serious work based on scientific principles, ly that of the late Dr. CLEMENTE GRIMALDI of Modica can be considered, l to him are due some hybrids which have been successfully introduc- into general cultivation. From the beginning of his short career this tinguished worker was actively and usefully employed, thanks to his hnical skill, in the production of hybrids suitable for warm districts. portant observations on American vines in general, which he was able make during the course of his researches, are still turned to advan-e by a certain number of Italian and other growers of American vines.

Although the work of Grimaldi was unfortunately interrupted by early death, the vine growers have been able to profit by his labours some extent, thanks to certain hybrids of special interest among which following may be mentioned.

G. 1257 (Berlandieri × Regano). This hybrid is suitable for strongly carious soils. It has given good results at Mazzara del Vallo and at Casa inca (Marsala) where it has developed remarkably well in spite of the ure of the soil ; calcareous, somewhat poor, and dry.

G. 444 and 446 (Berlandieri × Rupestris). Up to the present these brids have made good growth on calcareous soils.

G. 110 and 88 (Calabrese × Rupestris Ganzin) and 317 (Frappato × pestris Ganzin). These hybrids are adaptable within wide limits but

they give the best results on strong and light loams. They show we marked affinity for the Marsala vines but are liable to "bramble-leaf (roncet) by which they have been attacked in several experimental vin yards in Sicily.

G. 953 (Calabrese × Aramon Rupestris). This hybrid is a direct bearer and has given at Marsala on moist calcareous soils a good wine wit the proportions 16.2 per cent alcohol and 7 per cent of acidity (VAIARELLO

CONCLUSIONS.

From this brief account the following conclusions can be drawn:

1) The new resistant vines which are necessary for the reconsti tution of vineyards destroyed by phylloxera can be obtained (and hav already been partly obtained) by the selection of American vines grow from seed, and by the artificial hybridisation (followed by selection) of va rious American vines partly among themselves and partly with Europea vines. It was a mistaken policy to interrupt the work which had bee started on these lines, and to resort to the use of hybrids and selected plant imported from France. Indeed it is due to the clear-sightedness of some workers on American vines (RUGGERI, PAULSEN, GRIMALDI, LONGO that good plants produced and selected in Italy can be put into cul tivation today.

2) Experience acquired during a number of years has shown clearly that vines obtained and selected in France will not always live under con ditions different from those of the country of their origin, as in Sicily, Sar dinia, Calabria, and Apulia. The introduction of these French vines into Italy was in many cases unsuccessful and consequently the workers on American vines turned their attention once more to the production and the study of indigenous resistant vines. It was a judicious action on the part of the Ministry of Agriculture in 1914 to direct that the institutions under Government control should resume the work interrupted some years pre viously.

3) The work of PAULSEN, GRIMALDI and RUGGERI, can be put to profitable account to-day, for the hybrids due to them can, especially in warm districts, replace the vines produced and selected in France. In other districts it is unnecessary to give up French vines entirely, but the Riparia and Rupestris selected by LONGO at Velletri, besides the hybrids of PAULSEN can, with advantage, be introduced into general cultivation.

SECOND PART.

ABSTRACTS

GENERAL INFORMATION.

DEVELOPMENT OF AGRICULTURE IN DIFFERENT COUNTRIES

1 - **Agriculture in Brittany.** — I. PIC, G. Monographie d'une exploitation modèle en Ille et-Vilaine. *La Vie Agricole et Rurale*, Year 6, No 27 (special number on Brittany), pp. 1-8. Paris, July 1, 1916. — II. PARISOT, F. Mise en valeur des dunes. *Id.*, pp. 5-7. — III. MÉGE, E. La culture de l'ajonc *Id.*, pp. 13-16. — IV. MÉNARD, A. Culture de la pomme de terre de primeur dans les Cotes du Nord. *Id.*, pp. 18-20. — V. VINCENT, V. Cultures maraîchères et élevage du cheval combinés dans le pays de Léon *Id.*, pp. 20-22.

I. Small holdings of from 35 to 50 acres are the rule in the department of Ille-et-Vilaine, and farms of over 100 acres are rare. Much of the land is owned by peasant proprietors. The farm selected for description as being typical of the district is about 35 acres in extent, on gently undulating ground, and the soil is a strong loam on a clay subsoil. Many improvements have been carried out: the land has been drained; roads have been made and apple trees planted on either side of them; hedges have been removed, so that the farm now consists of 4 or 5 arable fields of 5 to 7 acres each, 5 acres of grass and 2 ½ acres of orchard. No fixed rotation is adopted, but as far as possible the annual acreage of crops and catch crops is distributed as follows:

3 ½	acres	winter wheat	
3 ½	»	winter oats	
3 ½	»	spring »	
3 ½	»	barley	
2 ½	»	buckwheat	
5	»	red clover	
2 ½	»	rape	
4	acres	green rye	
4	»	trifolium	
1 1/4	»	vetches	
1 1/4	»	maize	
2 ½	»	mangels	
1 1/4	»	carrots	
1 1/4	»	cabbages	
1 1/4		potatoes	

Besides this, all banks are planted with gorse which yields valuable fodder for horses and cattle in December and January. Thus the 30

acres of arable land not only produce about 30 acres of fodder and gra crops consumed on the farm but also an additional 10 acres of corn cro which are sold away. Average yields for the last 10 years have been:

wheat	5	qrs. per acre
oats	7	» » »
buckwheat	5	» » »
mangels	28	tons per acre
potatoes	9 ½	» » »

The dead stock consists of 2 ploughs, 1 set of harrows, 2 cultivator 2 horse hoes, 1 small horse drill, 1 mower with corn cutting attachment, swath turner, 1 horse rake. The live stock consists of: (1) a dairy her of 10 to 12 milking cows (also 3 or 4 heifers, 3 or 4 yearlings and 2 bull yielding from 22 ½ cwts. to 28 ½ cwts. of butter per annum and a gro profit of £120 to £165, besides 7 or 8 calves sold fat to the butcher f £20 to £24; (2) one old horse and 2 mares from which one foal is bred an nually and sold; (3) about 50 hens and pullets of the de Janzé breed; an (4) a number of pigs.

The labour is provided by the farmer and his family, a maidservan and a man living in the house, and during the busiest seasons of the yea additional men are occasionally hired by the day.

The returns of this type of holding are excellent in the majority cases and where the farmers, who are generally industrious and fairly e lightened, have also been good business men and skilful cultivators, actu fortunes have been made out of the land.

II. The sand dunes extend over many thousands of acres along th northern and southern coast of Brittany. They are covered by a meag vegetation consisting chiefly of couch grass, sand sedges, small fescue sweet vernal, cock's foot and timothy, with occasional clumps of furz *Ephedra*, asparagus, various medicks, bracken, wild beet, and here an there a pine wood. The dunes are usually either State owned or the pro perty of the communes. In certain parts they have been successfully re claimed as for instance at Rothéneuf near St. Malo where early vegetable are now grown at a profit, at Roscoff, at Saint-Paul-de-Léon and at Plou hinec near Lorient which is celebrated for its early carrots.

The work of reclamation should always start with ploughing to a depth which varies with the flora. Liming and chalking are useless at the initial stage, but farm yard manure or seaweed must be applied with dressings of superphosphate and potash salts. Levelling should be carried out as fa as possible. The most important question is that of protection against wind. In points of extreme exposure *Atriplex*, tamarisk, sea-buckthor or gorse should be used as wind screens, while white poplar, *Cytisus*, elm and the maritime fir may also be employed with profit. With regard t wind resistant crops the best results have been obtained with rye and cab bages. Once the land is under cultivation, early potatoes, green rye crimson clover and winter barley may be grown as well as asparagus an lucerne. After the early potatoes, green rye, etc... cabbages, mangel

rrots and salads or carrots and swedes, turnips, mustard should be ken, as the land will produce two good crops per annum if generously nured.

Its vicinity to the sea-shore makes this possible as the necessary weed can thus be obtained at low cost.

III. Gorse is a characteristic wild plant of all granitic or schist soils. bout 15 species are known including *Ulex europaeus, U. Gallii, U. Rich-ri, U. nanus, U. parviflorus*, and the two chief cultivated varieties are e Dinan and the Foxtail which is almost spineless. Gorse not only elds valuable fodder, but affords shelter and may also be used as litter or r green manuring. It has also been suggested as raw material for pa-r-making. As fodder it may be fed to all kinds of stock and cattle do rticularly well on it either when fattening or producing milk.

For its growth a good tilth is required and the land must be clean. ed may then be broadcasted at the rate of 18 lbs. per acre or drilled at e rate of 9 lbs. per acre as is customary in England. Average yields run om 10 to 12 tons of green stuff per acre which would be equivalent in eding value to 4 to 5 tons of good hay. Exceptional yields are said to ach 20 to 24 tons per acre. Seed may also be harvested and amounts to to 120 lbs. per acre of the common varieties (worth 10d. per lb.) or 40 50 lbs. of Foxtail (worth about 1*s* 3*d* per lb.).

Gorse leaves considerable residues of nitrogen in the soil and its deep ots break up the subsoil to a great depth. Plantations are easily broken even after being kept down from 6 to 8 years which is the usual dura-n of their life; some however are kept down as long as 15 to 20 years.

IV. The cultivation of early potatoes occupies an entire tract of ast land known as "the golden belt of Brittany" where the climate is ecially favourable. The most popular varieties are Royal Earlies (frost sistant), Mayette, Sutton, Giant Fluke, Fin de Siècle. Sets are carefully lected and sprouted in boxes or on floors during the autumn. Planting t begins at the end of January and the sets are placed very close together 0 in. × 14 in.), so that about 18 cwts. of seed potatoes are required per re. Yields are high, the total crop varying from 4 to 6 tons per acre d being worth anything from 3*s* 6*d* to 12*s* per cwt. In an average year e gross profits run from £24 to £32 per acre, but the crop is an expensive e to grow and would hardly pay if it were not for the fact that the tatoes can be followed by mangels, swedes, cabbages or cauliflowers and en by two successive corn crops without any further manuring.

V. The Léon district is not a purely market gardening district except the Roscoff commune. Elsewhere the market gardening is run together th a horse breeding industry and fodder crops have to be provided t the live stock. Though modified for the special requirements of these rms, the principles of market gardening still obtain and the crops are rely grown pure. For instance parsnips are interplanted with cauli-wers or artichokes, onions with parsnips, artichokes or cauliflowers, and uliflowers harvested in February would be followed by spring wheat in

which lucerne would be sown, or trifolium might be taken after the wheat A typical rotation is given below

1st year: spring wheat and turnips as a catch crop.
2nd year: parsnips with cauliflowers or artichokes.
3rd year: wheat or onions and trifolium.
4th year: cauliflowers.

The chemical requirements of such a rotation are considerable and even assuming that very heavy dressings of seaweed and farm yard manure are available, these should be supplemented by applications of fertilizer

1058 – **Blind Soldiers on the Land.** — BARONNE THÉNARD, A. (Note from the Valentin Haüy Association) in *Comptes Rendus des Séances de l'Académie d'Agriculture de France*. Vol. II. No. 21, pp. 595-602. Paris, 1916.

Ever since the beginning of the war the Valentin Haüy Association has undertaken the task of helping blind soldiers to earn their own livelihood and whenever it has been possible they have put such soldiers back to their old pre-war trades and occupations. On this principle large numbers of blind men should have been brought back to the land. The Association was already in touch with several men who were successful farmers poultrymen or bee-keepers in spite of having lost their sight, as for example the owner of a vineyard in Franche-Comté who though he became blind at the age of forty kept on working for many years. Another had been taught a trade specially adapted to the blind (straw and cane work), but preferred an agricultural occupation and rapidly became a skilful labourer The latter man was an immense help to the Association, for his case could be quoted to the blind soldiers and it could be pointed out to them that they had the advantage of being already familiar with farm operations. He was even charged in July 1915 to go round to the homes of blind soldiers and to show them by his practical example what could be accomplished without sight, to encourage them to be self-reliant, and to induce them to try to pick up the threads of their old life.

The results of this policy have been excellent: one man has gone back to an employer for whom he had previously been working for nine years, and has regained much of his old skill; another man, besides going back to his original work, has taken charge of 50 beehives to which he attends mostly at night; a third man who is not only blind but also suffers from slight deafness and a certain weakness in the right arm has taken up the management of a farm again and works himself in the garden and at pruning vines. All show remarkable pluck; but even the most able man when deprived of his sight is largely at the mercy of his surroundings and could accomplish little without the help and sympathy which are most surely found amongst his own people.

The Valentin Haüy Association is establishing a small poultry farm for blind soldiers, as experiment have recently shown in England that chicken rearing and tattening is work particularly well adapted to the blind.

CROPS AND CULTIVATION.

959 - **Measurement of the Surface Forces in Soils.** — SHULL, CHARLES ALBERT, in *The Botanical Gazette*, Vol. LXII, No. 1, pp. 1-31, 8 tables, 5 figs. Chicago, July 1916.

A contribution to our knowledge of the mechanics of soil moisture and ne relations of this latter to plant growth. The main purpose of the work as to find some means of measuring the force with which particles of ils of varying fineness retain moisture at different degrees of dryness and o obtain some more definite knowledge concerning the amount of "back ill" occurring in soils when the total moisture content is so low as to be navailable to growing plants. A number of experiments were carried out the relation of seeds to soil moisture, an aspect of the question which therto has not received the attention it deserves.

The *seeds* of *Xanthium* were chosen for the experiments owing to the pid re-establishment of moisture equilibrium relations after disturbance. hey were derived from 119 plants derived in their turn from the seed of single plant of *X. pennsylvanicum*; individual variations should therefore reduced to a minimum.

The *soils* used in the major portion of the work were 1) *the subsoil of Osw go silt* loam — a heavy clay — and, as a contrast to this, 2) *a fine artz sand* manufactured from quartz rock and, finally, 3) *various other l types*, details of which appear in table IV. The average composition No. 1 as determined by mechanical analysis was as follows:

Sand				Silt	Clay
Coarse	Medium	Fine	Very Fine		
0.4 %	0.5 %	4.4 %	3.2 %	61.3 %	30.4 %

The moisture equivalent was 35.2 per cent and the wilting coefficient 1 per cent.

No. 2 was a very pure quartz sand, the average diameter of the parti- s being very close to 0.10 mm. The moisture equivalent was 2.41 per t and the wilting coefficient 1.3 per cent.

Methods. — While the internal forces of *Xanthium* seeds have been roximated by osmotic means, many seeds lack semi-permeable coats. such seeds a vapour pressure method has been used which gives results ch are in a way comparable to the osmotic measurements. It consists ntially in measuring the vapour pressure equilibrium of the air-dry seeds r sulphuric acid of varying strength and calculating the internal pressure he seed from the vapour pressure of the solution over which it was found

TABLE I. — *Moisture intake of Xanthium seeds in osmotic solutions; temperature 23.5° C; intake in percentage of air-dry weight.*

Solutions volume molecular	1 hour	4 hours	7 hours	10 hours	24 hours	48 hours
H 2 O	16.39	44.38	48.78	50.38	51.18	51.58
0.1 M — Na Cl	16.79	39.43	45.87	46.48	46.39	46.33
0.2 M — Na Cl	17.12	38.67	45.00	45.57	45.93	45.52
0.3 M — Na Cl	16.07	34.05	40.75	41.95	42.24	42.05
0.4 M — Na Cl	14.36	31.21	38.08	39.97	40.33	40.27
0.5 M — Na Cl	13.96	30.26	35.87	38.08	38.70	38.98
0.6 M — Na Cl	13.80	25.57	32.41	33.57	34.77	35.18
0.7 M — Na Cl	13.32	26.29	30.99	31.73	32.79	32.85
0.8 M — Na Cl	13.13	25.22	29.21	29.95	31.12	31.12
0.9 M — Na Cl	12.58	24.34	27.64	28.95	29.14	29.79
1.0 M — Na Cl	11.90	22.92	25.42	26.48	26.21	26.73
2.0 M — Na Cl	8.19	14.55	18.25	18.43	18.60	18.55
4.0 M — Na Cl	4.81	8.37	9.84	10.08	11.00	11.76
Sat. — Na Cl	3.42	4.94	5.24	5.84	6.21	6.35
Sat. — Na Cl	— 0.67	— 0.77	— 0.58	— 0.58	— 0.58	— 0.29

to be in equilibrium. Though by no means exact the calculations near enough to the osmotic determinations to be of great interest.

The earliest soil measurements were made with No. 2) sand. Se of known weight were packed firmly in sand of known water content paraffined wire baskets, and allowed to come to equilibrium. The te were confined finally to the region of soil moisture from air-dry to the wi ing coefficient, because with a higher moisture content the seeds alwa became saturated with water. In the case of this sand it was not un the water content was reduced to about 1 per cent that a noticeable "ba pull" was developed by the soil.

This method is obviously open to the criticism that friction retards t movement of water in dry soils, and that the seeds therefore do not rea actual equilibrium with the total soil mass, but only with the soil lyi near them. In order to meet this difficulty, a rotation method (bottl arranged on rotating wheels driven by a motor) was adopted which brin the seeds constantly into contact with fresh soil particles.

TABLE II. — *Relation of Soil Moisture to Intake by Seeds.*

Soil moisture in percentage of absolute weight	Intake by seeds in percentage of air-dry weight	Osmotic pressure equal to surface force in atmospheres
.65	— 0.53	
.83 (air-dry)	0.00	Li Cl saturated = 965 atmospheres.
.95 (air-dry)	+ 0.38	
.66	0.97	
.15	1.58	
.23	1.91	(697)*
.46	1.06	
.61	3.73	(532)
.85	3.35	
.68	3.68	
.27	5.18	
.68	6.16	(418)
.92	6.25	
.16	6.55	
.36	6.47	Na Cl saturated = 375 atmospheres.
.26	9.58	
.32	10.76	
.81	9.81	
.16	10.82	
.60	15.79	
.79	11.94	4 M. Na Cl = 130 atmospheres.
.46	15.81	
.74	17.46	
.16	21.36	2 M. Na Cl = 72 atmospheres.
.91	21.11	
.23	23.88	
.78	20.62	
.88	28.61	M. Na Cl = 38 atmospheres.
.18	32.60	
.34	31.54	
.06	34.00	M. $C_{12}H_{12}O_6$ = 22.4 atmospheres.
.75	33.86	
.10	37.70	0.5 M. Na Cl = 19 atmospheres.
.12	41.98	0.4 M. Na Cl = 15.2 atmospheres.
.35	39.77	
.93	43.25	0.3 M. Na Cl = 11.4 atmospheres.
.07	41.79	
.07	45.15	0.2 M. Na Cl = 7.6 atmospheres.
.87	47.26	0.1 M. Na Cl = 3.8 atmospheres.
.34	49.31	
.71	43.79	
.80	46.54	
.04	50.00	
. . . .	51.44	Saturated = 0.00 atmospheres.

* Values in parenthesis calculated from the curve of moisture-holding power of the soil as determined by the known value.

Experimental Results.

A. *Measurement of the Seeds.* — The data resulting from the measure ment of the internal forces of *Xanthium* seeds by means of NaCl and LiC solutions are given in Table I and these figures may serve as a basis i the soil experiments, where the surface forces of the soil particles, instea of osmotic pressure are pitted against the internal forces of the seed.

B. *The Surface forces of Soils.* — *Soil No.* 1. The results of 4 of number of tests made with the subsoil of the Oswego silt loan men tioned above are shown in Table II.

Soil No. 2. — The results af a series of tests with the fine quartz sam running from air dry (0.14 per cent) to a little beyond the wilting coeffi cient (1.3 per cent) are shown in Table III.

Table III. — *Relation of moisture in No.* 2 *Quartz Sand to Moisture Intake of Xanthium seeds*

Soil H_2O in percentage of absolute weight	Intake H_2O in percentage of air-dry weight
0.14 (air-dry)	— 0.306
0.159	1.407
0.175	5.02
0.203	21.81
0.44	33.98
0.81	42.40
1.03	45.64
1.49	47.46
1.79	52.06
2.14	72.85*

* Four seeds showing incipient germination, hypocotyls averaging 3 mm. long.

Various soil types. — The foregoing results suggested that there migh be a general relationship between soils and seeds as regards the amoun of moisture seeds will absorb at the wilting coefficient of the soil, what ever value the wilting coefficient might have. To clear up this point th soil types of Table IV were used. Each soil was brought as nearly to th wilting coefficient as possible by addition of water.

ABLE IV. — *Relation of wilting coefficient to moisture intake by seeds*

Soil types	Percentage of hygroscopic moisture	Percentage of wilting coefficient	Percentage of soil H_2O	Percentage of seed intake
and (coarse)	0.205	0.73 ± 0.02	0.65	34.44
oam	3.130	12.93 ± 0.05	12.66	49.02
andy loam (very fine).	1.836	8.33 ± 0.08	7.86	48.38
oam	2.280	12.41 ± 0.02	13.30	49.01
lay loam	3.820	16.12 ± 0 01	16.01	49.49
lay loam	5.210	16.34 ± 0.02	17.78	47.31
ine sand	0.750	3.21 ± 0.03	3.19	49.77
and (coarse).	0.218	0.83 ± 0.01	0.80	40.98
oam	2.30	10.82 ± 0.06	10.51	50.42

Conclusions.

1) The force with which the seeds of *Xanthium pennsylvanicum* absorb ter has been measured by two methods : (*a*) osmotic solutions, and (*b*) pour pressure equilibrium. The osmotic method is at present the more iable.

2) The air-dry seeds of *Xanthium* show an initial attraction for water nearly 1 000 atmospheres.

3) The attraction which exists at any moistu.e content of the seed ween air-dry and saturation can be approximated. See Table I.

4) The seeds have in turn been used to measure the complex moisture-ling forces of soils, with the following results :

a) The air-dry subsoil of the Oswego silt loam holds its hygroscopic sture with about the same force as an air-dry seed, that is, about 1 000 ospheres.

b) As the moisture content of the soil increases, the surface force reases rapidly. When about 3.5 per cent of water has been added to air-dry soil, the force remaining is about 395 atmospheres. When the moisture reaches 6 per cent above air-dry in this soil, the moisture is l with a force of 130 or more atmospheres. At 11 per cent above air- the holding power has fallen to 22.4 atmospheres.

c) At the wilting coefficient of the soil (13.3 per cent above air-dry the Oswego silt loam subsoil) the " back pull " of the soil particles a- unts to not more than that of a 0.1 M Na Cl solution, that is, not more h about 4 atmospheres. This is shown to hold true for a number of es of soil with widely varying wilting coefficients.

5) This water-holding power of soils at the wilting coefficient is less

than the osmotic pressure of the root hairs of many kinds of plants, as shown by HANNIG and others.

6) The wilting of plants at the wilting coefficient of the soil cannot be due to lack of moisture in the soil, nor to lack of a gradient of forces tending to move water toward the plant.

7) The view is held, therefore, that the wilting at this critical soil moisture content must be due to the increasing slowness of water movement from soil particle to soil particle, and from these to the root hairs, the rate of movement falling below that necessary to maintain turgidity of the cells of the aerial parts, even under conditions of low transpiration.

1060 – **The Treatment of Peat Beds to Prevent Loss of Nitrogen Due to Bacterial Activity (Germany).** — AREND, T. in *Landwirtschaftliche Jahrbücher*, Vol. 49, No. 2, pp. 191-213. Berlin, March 25, 1916.

At the Bremen station for peat investigations, experiments were carried out to determine whether denitrification and the decomposition of nitrates in peat beds could be prevented. The problem was attacked by two methods: (1) soil conditions were made such as to encourage nitrification and processes favourable to plant growth; and (2) the reduction of nitrates was inhibited by the use of germicides. By the first method denitrifying organisms alone were affected while by the second method the destruction of both denitrificrs and nitrate reducers was involved.

1*st. method.* — The soil used was from a well rotted peat bed, crumbly and rich in bacteria. On analysis it proved to contain fair quantities of ammonia and traces of nitrates, but no nitrites. The sample was put through the 3mm. sieve and mixed with pure calcium carbonate at the rate of 0.3 gm. of carbonate to 40 gms. of soil (these proportions having previously been shown to produce maximum nitrogen losses). The soil was watered to bring it up to its original water content and placed in glass vessels in layers 0.8 cm., 3 cms., and 9 cms., thick; 0.5 gm. of dry nitrate was added to each vessel which was then plugged with cotton wool and incubated for a fortnight at 28° C. The amount of denitrification which had taken place was then determined.

The results showed conclusively that denitrification varies with the depth of the soil layer in the vessels, *i. e.* with the amount of oxidation which can take place. In other words, the greater the relative surface exposed to the air, the more are the oxygen needs of the soil bacteria satisfied and the smaller the loss of nitrogen and the reduction of nitrates. The mean total loss of nitrogen for the three layers 9 cm., 3 cm., and 0.8 cm. were 17.8 mgms., 2.1 mgms, and 3.8 mgms. respectively. Where the soil was very loosely packed, no denitrification took place, but in other cases even thin layers of less than 1 cm. thickness showed losses of nitrogen, and it may be concluded that under field conditions where the soil could never have such a large surface exposed as in these experiments, denitrification could never be completely prevented.

In practice, therefore, tillage and drainage of peat soils may be always recommended in order to minimise denitrification, but some losses must always be expected from that cause.

2nd. method. — In the series of experiments where germicides were ed, the same apparatus was employed, but the soil layers were uniform 9 cms. thick. The germicides were mixed with the soil in the dry ate or in solution at the rate of 25 to 200 mgms. per 60 to 70 gms. of soil ontaning 80 per cent of water).

Copper sulphate. — Even with the maximum doses of 0.2 gm. $CuSO^4$ I^2O per 12 gms. of dry soil, losses of nitrogen were not completely voided. With the small doses, denitrification was intensified. This unexcted behaviour on the part of copper sulphate was probably due to the fact at the greater part of the salt is precipitated as humates in a peaty soil and us loses its toxicity. The humates which are hardly ionised actually emed to have a stimulating effect on the denitrifying bacteria.

Magnesium sulphate and zinc sulphate. — Neither of these salts totally hibited denitrification. With zinc sulphate the action was diminished a tle, but with magnesium sulphate it was nearly always slightly increased. obably with both these salts too the results are due to the formation of n-ionised humates.

Non-ionisable substances. — In a last series of experiments, disinfectits which did not owe their germicidal properties to ions were used: e. carbolineum, toluene and carbon bisulphide. Where carbon bisulide was used the period of incubation was increased from two to five weeks ring which time the soil was maintained at ordinary room temperature stead of at 28° C. The following results were obtained: carbolineum inased denitrification; toluene had no stimulating effect in whatever oportion used but neither did it have an inhibitive effect except in one gle instance; carbon bisulphide on the other hand always decreased nitrification even when used in very small doses.

It would therefore appear that on peaty land, carbon bisulphide may recommended as the best germicide to employ.

5r. **The Chemical Composition of Plants as a Guide to the Fertility of the Soil.** — Savvin P. in *Журналъ Опытной Агрономіи* (Review of Agricultural Experiments) Vol. XVII, No. 1, pp. 1-12, Petrograd, 1916.

Two series of investigations were carried out to determine the relaıship between the phosphoric acid content of the plant and that of the l in which it had been grown. In the first series oats were grown in sand which nutrient solution was added. Each vessel contained 7 kg. of sand d the nutrient solution was that of Prianichnikoff, *i. e.* phosphoric acid the form of $Ca\,HPO^4 + 2H^2O$ and nitrogen in the form of ammonium nite, both being used in the proportions laid down by Hellriegel. The lution was used at normal strength, double strength and treble strength. the second series of experiments the sand was replaced by two soils, e of which was a poor sandy forest soil from the Agricultural Institute Moscow and the other a tchernozium (black soil) from the Kharkov gricultural Station, unresponsive to phosphate manuring. Calcium phohate and potassium nitrate were added in quantities equal to normal rength and to 2, 4 and 8 times normal strength.

When the oat plants were harvested, the grain was separated from the

straw and both were analysed. It was found that the phosphoric acid content of the grain varied very little while that of the straw reflected to a much greater extent the phosphoric acid content of the culture medium. The sand cultures gave the following figures:

	Phosphoric acid content	
	in straw	in grain
Normal strength	0.6503 per cent	0.2844 per cent
Double "	1.458 " "	0.2982 " "
Treble "	1.834 " "	0.2865 " "

In the grain the phosphorus was present almost wholly in the form of organic compounds while in the straw only phosphates were found. The phosphate content of the plant, therefore, varied considerably according to the available amount of phosphoric acid in the culture medium, but the organic phosphorus remained almost constant varying only within the limits of 0.41 and 0.60 per cent. The organic phosphorus was not affected by the total weight of the plant and only to a slight extent by the amount of phosphoric acid absorbed by the plant. Where the nutrient solution was used in a concentrated form, considerable amounts of phosphoric acid were taken up by the plant, but only a very small portion of this was converted into organic compounds of phosphorus, the main part being deposited as phosphate in the straw.

From these results, it should be possible to draw the practical conclusion that a high percentage of phosphate in oat straw indicates the presence of a considerable amount of phosphoric acid in the soil. But it is pointed out that other causes such as general conditions of growth may also affect the percentage of phosphates in plants, indeed the writer's own experiments of 1913 and 1914 gave results directly contradictory to those obtained in the above trials and are supported by the evidence of other authorities (HALL, SEELHORST, ATTERBERG). On the whole, therefore, it cannot be considered that the determination of the phosphate content in oat straw affords a reliable guide to the condition of the soil, but in special cases it may yield useful information.

1062 – **The Influence of Relative Area in Intertilled and Other Classes of Crops on Crop Yield.** — BRODIE D. A. in *United States Department of Agriculture, Office of the Secretary, Circular* No. 57, pp. 1-8, Washington, March 31, 1916.

Experience has taught that there is a limit to the extent to which land may be occupied by the same class of crops without detriment to crop yield, and this experience has led to the adoption of rotations. Just what proportion of the crop should be planted to intertilled crop (*i. e.* corn, potatoes, tobacco, etc., planted in rows and cultivated between the rows), what to grain crops, and what to perennial grass, to prevent serious injury to the soil, are questions that the farmer has always had to answer for himself, largely from his own experience or from the established custom of his locality.

During the past two years studies as to the relation of the type of

rming to the maintenance of crop yield have been made on 240 farms in ester County Pa., and on 303 farms in Central Illinois. Use has also en made of the data compiled for 377 other farms in Chester, Co. Pa. d 300 farms in Lenawee Co. Mich. The studies consisted in comparing e productive capacity of the various farms by means of their "crop dex" which may be defined as the crop yields of a particular farm ex- essed in percentage of the average crop yields in the community.

Results of the investigations indicated:

1) That there seems to be in all districts so far studied an optimum rcentage of the crop area of the farm which can be devoted to a single ss of crops and maintain maximum yields. Even under the rather in- sive types of farming prevailing in Chester Co. Pa. and in Lenawee Co. ch., and under the more extensive type of farming in Central Illinois, e optimum area of intertilled crops in each case falls within 5 per cent each other, the range being about 32 to 36.

2) That when more than this percentage of area is devoted to a single ss of crops, yields decrease even where there is an increase in the number live stock per acre.

3) That in Chester Co. Pa. the optimum percentage area for peren- l grass (timothy and clover) is about 36 per cent of the crop area of the m.

4) That data of this character make it possible to construct a crop- g system which should under average conditions, produce maximum ds with a given quantity of manure. In the case of Chester Co. such a tem constructed from data brought out in the 1912 survey corresponds y closely to the practice of those farmers who maintain high yields and of se who have made highest profits.

These conclusions were arrived at as follows: the relation between crop yield, the percentage of the crop area of the farm in intertilled s, and the average number of live stock per acre was determined for ster Co. Pa. and for Central Illinois (Tables I and II).

The relation of non intertilled crops to crop yield was next investiga- (Table III) and finally that of perennial grass (timothy and clover) rop yield (Table IV).

The results show that the best distribution of area amongst the diffe- classes of crops occurs when 10 per cent is allowed for crops not in the tion such as garden, orchard, soiling crops etc., 36 per cent is under rtilled crops, 36 per cent in perennial grass and the remaining 18 per cent nual crops not intertillied. To illustrate how nearly this corresponds ie actual practice of the most successful farmers, Table V shows the crop percentages of the 27 Chester Co. farms having the highest yield and ie 27 having the lowest yield. There is a close agreement between the ping systems selected for high crop yields andt hat producing the high- profits and this agreement indicates that a well balanced type of agri- ire prevails in Chester Co. Where this condition does not prevail yields are obtained to the sacrifice of profit or high profits are made at sacrifice of soil fertility.

TABLE I. — *Relation of per cent of crop area in intertilled crops to crop index in Chester Co. Pa.* (1914 *survey*).

No. of farm	Per cent of crop area in intertilled crops		Average no. animal units (1) per 100 *acres* in crops	Average crop index
	Range	Average		
72	Less than 25	20.8	37.6	96
58	25–30	27.4	41.2	100
53	30–35	32.7	48.4	105.2
57	35 or more	41.4	53.4	104.7

(1) An animal unit is a mature horse or cow or as many smaller animals as require the feed horse or cow, *i. e.*, 2 head of young cattle; 5 hogs, 7 sheep, or 100 hens.

TABLE II. — *Relation of per cent of crop area in intertilled crops to crop ind in Central Illinois* (1913 *survey*).

No. of farms	Per cent of crop area in intertilled crops		Average no. animal units per 100 *acres* in crops	Average cro index
	Range	Average		
75	Less than 37.5	28.4	19.3	102
72	37.6–48.9	43.3	18.1	103
82	49.0–59.9	53.9	17.1	100
74	60 and over	73.6	15.8	93

TABLE III. — *Relation between the per cent of the crop area in annual cr not intertilled and crop index in Chester Co. Pa.* (1914 *survey*).

No. of farms	Percentage of the crop in annual crops not intertilled		No. of animal units per 100 *acres* in crops	Average cr index
	Range	Average		
64	Less than 18	14.2	51.9	105
73	18–24	26.0	44.5	102
48	24–30	26.9	39.8	99
53	30 and over	34.9	36.8	97

ABLE IV. — *Relation of per cent of crop area in perennial grass to crop index in Chester Co. Pa.* (1914 *survey*).

No. of farms	Per cent of crop area in perennial grass		No. of animal units per 100 *acres* in crops	Average crop index
	Range	Average		
64	Less than 32	22.9	46.7	102
48	32–39	34.7	44.8	105
57	40–45	41.7	44.2	102
09	45 and over	51.7	40.8	98

BLE V. — *Average percentage of area of intertilled crops, annual crops not intertilled, and perennial grass, Chester Co. Pa.,* (1914 *survey*).

Class of crops	Average percentages				
	On 240 farms	On 27 farms showing highest yields	On 27 farms showing lowest yields	Modified for: highest yields	Modified for: highest profits (1)
ertilled	28.4	34.0	27.1	36	34–43
uals not intertilled	22.3	18.8	23.4	18	10–19
nnial grass	38.0	38.2	39.4	36	40–50 (2)
rden, orchard, etc.	11.3	9.0	9.8	10	—

(1) The figures for this column are derived from a 1912 survey.
(2) All hay crops including annuals.

5) - **"Tetraphosphate".** — VINASSA, G. (Turin Agricultural Experiment Station) in *Le Stazioni Sperimentali Agrarie Italiane*, Vol. XLIX, Nos. 7–8, pp. 357–365. Modena, 1916. MANURES AND MANURING

"Tetraphosphate" is a new fertiliser recently put on the market, d has been suggested as a substitute for basic slag. It is prepared by xing powdered phosphorite with carbonates of the alkaline earths (at the e of 6 per cent by weight of the carbonates) and heating the mixture 400° C. in special ovens. The mass is then moistened and inert bodies e added till a substance containing 20 per cent of total phosphoric acid obtained. The finished product is a dry, greyish-white powder, al- st insoluble in water with which it gives an alkaline reaction, and partly uble in acids which cause an evolution of carbon dioxide.

"Tetraphosphate" was treated with a number of solutions and the ubility of its phosphoric acid was determined; similar tests with Sfax psphorite were carried on at the same time. The results are given below.

Comparative solubility of "tetraphosphate" and phosphorite.

Solvent	Grams P_2O_5 per 0.71 gm. phosphorite	Grams P_2O_5 per 1 gm. tetraphosphate
Water	trace	trace
Water saturated with CO_2	"	"
Saline solutions (NaCl and $NaNO_3$, NH_4Cl and $(NH_4)_2SO_4$)	"	"
Ammonium acetate 18 %	0 0009	"
Ammonium malate 40 %	0 0009	"
Ammonium tartrate 20 %	0 00016	0 00015
Ammonium citrate 40 %	0 0163	0 0100
Citric acid 0.5 %	0.0235	0.0166
Citric acid 2 %	0.0529	0 0252
Citric acid 10 %	0.1217	0 1041
"Citroformic" acid (4 % citric acid, 6 % formic acid, 10 % NaCl)	14.04 per cent	13 79 per cent

"Citroformic" acid was proposed as a reagent by the inventor of "tetraphosphate", yet even with this solvent, phosphorite shows a higher percentage of soluble phosphoric acid than does "tetraphosphate", and with all the other solvents the same thing was observed. These results would indicate that no valuable changes take place when the phosphorite is heated with the carbonates of the alkaline earths, and that the process which is complicated and costly is also useless. The name "tetraphosphate" is very inappropriate as its insolubility clearly proves it to contain neither tetraphosphate nor calcium silicophosphate both of which products have been isolated from basic slag, by HILGENSTOCK and CARNOT. From the purely chemical point of view, there is no analogy between basic slag and "tetraphosphate" which may be simply considered a ground phosphate mixed with inert compounds.

Occasional satisfactory results obtained by farmers with this substance and said to demonstrate its particular efficiency should be looked upon as inconclusive.

1064 – **Lucerne Inoculation Experiment, Hawkesbury Agricultural College (New South Wales) 1912-16.** — HEINRICH J. O. in *Agricultural Gazette of New South Wales*, Vol. XXVII, No. 5, pp. 305-313. Sydney, May, 1916.

An experiment was conducted at the Hawkesbury College during the years 1912-16 to contrast the various methods of inoculation for lucerne on manured and unmanured land and to ascertain their practical value in establishing lucerne on soil which had not previously borne it. The ground chosen for the experiment was a plot of well drained, uniform, red sandy loam. Methods of inoculation were as follows:

1. Inoculation of seed with lucerne rhizobia.
2. " " soil " " " before sowing.
3. " " " " " " after germination
3a " " " " " " when half grown.
4 " " " " soil of similar composition from an established lucerne area
5 " " " " " soil of dissimilar composition from an established lucerne area
6. " " seed with vetch rhizobia.

TABLE I. — *Result of examination for nodules three months after sowing.*

Method of inoculation	Manure	No. of plants examined	Plants with nodules on roots		Remarks
			Number	Per cent	
eck		44	0	0	
oculated after germination.	No manure	69	12	17	Fairly large; 3-4 on a plant.
	Lime	70	55	79	Large to medium; scattered; average 5.
	Complete manure	70	15	21	Large size; scattered.
eck		75	0	0	
eck		83	2	2	
oculated before wing.	No manure	70	2	3	
	Lime	128	107	84	Medium; scattered; average 6.
	Complete manure	84	6	7	Scattered.
eck		66	1	2	
eck		69	1	1	
d inocu'ated ith lucerne rhi- obia.	No manure	69	0	0	
	Lime	32	7	15	Small; average 5.
	Complete manure	63	5	8	
eck		77	0	0	
eck		64	0	0	
ot inoculated.	No manure	62	0	0	
	Lime	75	1	1	
	Complete manure	66	0	0	
eck		76	0	0	
oculated with oil of the same omposition	Complete manure	89	55	62	Average 6; scattered.
	Lime	85	82	96	» 7; »
	No manure	94	79	84	» 6; » ; at top.
oculated with oil of different omposition.	Complete manure	74	4	5	
	Lime	85	56	64	Average 3; scattered.
	No manure	78	6	8	Scattered.
eck		62	0	0	
eck		97	0	0	
eck		72	0	0	
d inoculated ith vetch rhi- obia.	No manure	64	0	0	
	Lime	72	0	0	
	Complete manure	73	0	0	

TABLE II. — *Relative yields of lucerne* 1913-14, 1914-15.

Method of inoculation	Manure	Relative yield, check plot = 100
Inoculated after germination	No manure	86.03
	Lime	105.60
	Complete manure	102.88
Inoculated before sowing	No manure	86.01
	Lime	106.72
	Complete manure	119.51
Seed inoculated with lucerne rhizobia	No manure	74.72
	Lime	112.82
	Complete manure	117.03
Not inoculated	No manure	85.30
	Lime	115.79
	Complete manure	113.16
Inoculated with soil of same composition	Complete manure	94.52
	Lime	107.14
	No manure	102.29
Inoculated with soil of different composition	Complete manure	100.03
	Lime	117.35
	No manure	106.56
Seed inoculated with vetch rhizobia	No manure	89.04
	Lime	102.51
	Complete manure	99.34

The land after being carefully prepared, was divided up so that eac method of inoculation except 3*a* was tried with: *a*) no manure, *b*) lime a the rate of one ton per acre and *c*) complete manure (1 cwt. superphos phate, ½ cwt. sulphate of potash, ½ cwt. sulphate of ammonia per acre) About three months after sowing, samples of roots were examined for no dule formation with the results given in Table I. Ten months after the layin down of the experiment another examination was made for nodules. Th results obtained were similar to the previous ones, but it was evident that the earlier examination was the more reliable as the older the plant thi deeper are the fine roots on which the nodules are found and the greate the difficulty in uprooting them. Moreover if the treatment is efficacious nodules will be found on the young plant as early as six months after ger mination. Finally in February and March 1916, four years after the begin

g of the experiment, a further examination for nodules was carried out. this time all the plots contained lucerne rhizobia.

From Table I it will be seen that:

1) The method of artificial inoculation with cultures of lucerne zobia are far from being as efficient nodule producers as the inoculation h soil of the same composition as the land being treated.

2) Inoculation with rhizobia from a legume other than lucerne is ffective when used with the latter crop.

3) The addition of lime greatly increases the nodule forming power.

Whereas these deductions are in full accord with those of other investitors, the present experiments gave results different from those obtained other parts of the world as regards yield. In Table II will be found the ures for the 1913-14 and 1914-15 harvestings from which it is evident at inoculation had a depressing effect on the yield when used alone or in njunction with lime or complete manures.

AGRICULTURAL BOTANY, CHEMISTRY AND PHYSIOLOGY OF PLANTS

06. **The Application of Botanical Science to Agriculture.** — HOWARD ALBERT (Imperial Economic Botanist, Pusa) in *The Agricultural Journal of India*, Special Indian Science Congress Number pp. 14-26. Calcutta and London, 1916.

A study of the literature dealing with agriculture indicates that there some confusion of ideas as to the precise relation which exists between e science of botany on the one hand and the practice of agriculture on the her. In the present paper, an attempt has been made to define the bearg of the scientific aspect of the vegetable kingdom on the economic delopment of crop production and to show how a knowledge of this science n best be applied to agricultural problems. For any real advance to be ade in crop-production, a thorough scientific knowledge of botany in all s branches is one of the first conditions of progress. This will be clear if the al problems to be solved are considered in all their bearings.

The attempt to improve cultivated crops by scientific methods is a reent development and can be traced to two main causes - (1) the gradual cognition of the fact that in agriculture the plant is the centre of the subct; and (2) the rapid rise of the study of genetics which followed the rescovery of Mendel's results in inheritance.

The importance of the plant in crop production may be said to be genally recognized at the present time. A large number of botanists are ing employed at Experiment Stations and the public have often been d to expect that a revolution is about to take place, particularly through e application of what is popularly known as Mendelism. A critical exanation of the literature discloses some signs that these extravagant pes are not likely to be fulfilled, not that these hopes are impossible but ther because the problems have not always been taken up on a sufficiently oad basis and attacked simultaneously from several standpoints.

II. *The Development of Botany.*

The more recent developments in botanical science are fortunately ltending to a study of the plant as a living whole. Both the scientific study the field of plant associations (ecology) and the systematic examination the various generations of plants raised from parents which breed true

(genetics) are doing much to mitigate the evils which follow from undue devotion to purely laboratory work. Ecology and genetics are taking the botanist into the field and will, in all probability, materially influence the future development of the science. This will be all to the good and should do much both to raise the standard and emphasize the importance of field work and also develop the natural history side of botany. The botany of the future is likely to combine all that is valuable in laboratory work with modern ideas on ecology, classification, and genetics.

The relation of Botany to Agriculture.

A wide scientific outlook on the many aspects of plant life is the first condition in applying botanical science to practical problems. The next step for the botanist is to study his crop in the field and to learn to appreciate the agricultural aspects of crop-production. The investigator must himself be able to grow his crop to perfection and it is not too much to say that no real progress can be made without this. The ordinary agricultural processes applied to any crop bear a direct relationship to the physiological necessities of the plant and have been evolved from centuries of traditional experience. In all investigations on crops, a first-hand knowledge of practice is necessary and nowhere is it so important as in plant-breeding work where practice is quite as valuable as an acquaintance with the methods and results of genetics. The greatest devotion to the study of inheritance, using for this purpose material indifferently grown, is largely labour lost as many characters are masked unless the plants are really thriving and well developed. For instance in wheat, the red colour of the chaff never develops in badly grown plants thereby causing great confusion in systematic and breeding work on this crop. In tobacco, the various leaf characters are almost entirely masked by bad cultivation and their inheritance can only be studied if the crop is grown to perfection.

Science and practice must be combined in the investigator who must himself strike a correct balance between the two. The ideal point of view of the improver is to recognize agriculture as an art which can best be developed by that instrument called science. Once this is fully realized and acted upon, the place of the experiment station in agriculture will be understood as a matter of course and the qualifications needed by the workers will be self-evident. There will be little or no progress if practical agriculturists are associated with pure scientists in economic investigations. This has often been tried and has never yielded results of any importance. The reason why such co-operation fails is that without an appreciation of practice the scientist himself never gets to the real heart of the problem. The history of the indigo investigations in India is a very good case in point. During the last 20 years, a number of scientists have been employed in an endeavour to improve the production of natural indigo. Over £50,000 have been expended on this work between 1898 and 1913 but no results have been obtained, largely because the scientists preferred to engage European assistants on indigo estates to grow their experimental crops rather than to cultivate them themselves. The result was that the real problems were not discovered, a large amount of ineffective work was done and valuable

ne was lost during which the natural indigo industry declined and the nthetic product rapidly established itself in the markets of the world. e solution of the indigo problem has recently been disclosed by a study the plant in the field. It is not too much to say that if a properly qua- ied botanist with a knowledge of agriculture had attacked the indigo pro- em twenty years ago, the history of this industry would have been very fferent.

There remains for consideration the commercial aspect of investiga- ns on crops and the necessity, on the part of the worker, of keeping in se touch with the requirements of the trade. Particularly is this impor- nt in the case of materials used in textile industries like cotton where any arked alteration in the raw product might easily involve extensive changes machinery. In the case of cereals like wheat, it is necessary in improving e variety to follow closely the needs of the manufacturer and to ensure et any new types introduced into general cultivation can be milled to lvantage. The successful merchant often possesses information which of the greatest value to the botanist and which helps the investigator to ceive the manner in which an improvement can most effectively be made.

That a combination of science, practice, and business ability in the ne individual is essential in all agricultural investigations dealing with e plant will be evident if the kind of problem awaiting solution is consi- red in detail. Many of these questions fall into the following three sses :

(1) *Improvements in the efficiency of the plant.* — Any attempt to increase e output of a crop can only be successful if the the physiology of the ant is considered together with the economic aspects of production. Such oblems have to be solved within the working conditions of the plant fac- ry and also within the general economic limits imposed by labour and pital. In such matters, the investigator might easily go astray unless keeps the laws of plant physiology in view and unless he is fortified by knowledge of practice and an appreciation of the general working con- tions.

(2) *The treatment of disease.* — The inadequacy of much of the experi- nt station work on the diseases of plants, in which fungi and insects e concerned, has recently been referred to by Professor Bateson in one of e sectional addresses to the British Association.

In the course of his speech, this gentleman drew attention to the fact at there is at the present time hardly any comprehensive study of the orbid physiology of plants comparable with that which has been so great- developed in application to animals. The nature of the resistance to sease, characteristic of so many varieties, and the methods by which it ay be ensured, offer a most attractive field for research, but it is one in hich the advance must be made by the development of pure science, id those who engage in it must be prepared for a long period of labour ithout ostensible practical results.

(3) *The creation of improved varieties.* — In this work an understanding the needs of the crop and a knowledge of systematy and genetics must

be combined with the insight of the inventor, no possible scientific metho can succeed without the intuition of the breeder. Any attempt to obtai or record the characters of large numbers of plants and to obtain the fine selections by a scientific system of marks is hopeless, as the investigato would be a speedily swamped by the volume of his material. The insigh of the breeder is necessary for the work and the judgment, which comes b practice, in the rapid summing up of essentials by eye is far more useful tha the most carefully compiled records or any system of score cards. The suc cessful plant breeder is to a large extent born and not made. Science help the born breeder by providing him with new and better instruments and by bringing knowledge to bear from many sides, it accelerates the outpu and lightens the work in a multitude of ways.

1066 – **A Biochemical Study of Nitrogen in Certain Legumes.**— WHITING, A. L. *University of Illinois, Agricultural Experiment Station, Bulletin* No. 170, pp. 471-512. Urbana, Ill March 1915.

The writer discusses the whole question of nitrogen fixation by legu minous plants and gives an account of his own experiments on the sub ject. These he divides into two parts:

I. *Studies to determine through which organ legumes obtain atmos pheric nitrogen.* The plants used were the soybean (*Glycine hispida* Maxim and the cowpea (*Vigna unguiculata* Walp). Uniform seeds were carefully selected and inoculated with an infusion of *B. radicicola*. The plants were grown in silver sand to which a nutrient solution was added, both sand and solution being free from nitrogen. Wolf bottles were used as con taining vessels in order that the atmosphere around the roots should be controlled, and whereas the roots of some plants were maintained in a gas current consisting of 96 to 98 per cent of oxygen and 2 to 4 per cent of carbon dioxide, others were maintained in a current of air. At the end of each experiment the nitrogen was estimated in each plant, and the amount fixed was determined. Results are given in Tables I and II.

The error in soybeans nos. 1 and 2 was partially accounted for by a slight injury to these plants by grasshoppers and red ants. There was also a small experimental error. The fixation shown by cowpea no. 2 was also attributed to a leak around the stem which prevented the Wolf bottle from being gas tight. All plants receiving air had well developed nodules.

The experiments were repeated and the results were confirmed. In order to test the viability of *B. radicicola* after exposure to the abnormal atmosphere, infusions were made from the roots of plants grown in the oxygen current and applied to cowpea seeds that had been sterilized and planted in sterile sand. Sterile conditions were maintained throughout the test. Profuse nodule formation resulted, showing that the viability of *B. radicicola* had been in no way impaired.

Plants grown in the oxygen current usually developed two and some times three leaves before they seemed to be checked in their growth. Soon an interesting translocation set in. Each plant removed the nitrogen from the lower leaves and developed a new leaf of a normal green colour

TABLE I. — *Fixation of nitrogen by soybeans.*

No. of plant	Treatment	Nitrogen in plant after 28 days	Nitrogen in seeds	Nitrogen fixed
		mgms.	mgms.	mgms.
1	$CO^2 + O$	10.43	11.4	— 0.97
2	$CO^2 + O$	10.65	11.4	— 0.75
3	Air	17.61	11.4	+ 7.07

TABLE II. — *Fixation of nitrogen by cowpeas.*

No. of plant	Treatment	Nitrogen in plant after 37 days	Nitrogen in seedlings at start	Nitrogen fixed
		mgms.	mgms.	mgms.
1	$CO^2 + O$	9.21	7.90	1.31
2	$CO^2 + O$	13.03	7.90	5.13
3	$CO^2 + O$	9.43	7.90	1.53
4	Air	24.84	7.90	16.94
5	Air	23.61	7.90	15.71

TABLE III. — *Total nitrogen in various parts of soybeans and fixation at different periods (gms. per jar of 5 plants).*

...ment	Age of plant	Nitrogen in tops	Nitrogen in roots	Nitrogen in nodules	Nitrogen in whole plant	Nitrogen in seeds	Nitrogen fixed
	days						
1	38	87.10	13.35	28.04	128.49	57.30	71.19
2	53	204.59	22.70	47.10	274.39	57.30	217.09
3	60	286.91	43.44	82.95	413.30	57.30	356.00
4	67	356.52	40.15	60.40	457.07	57.30	399.77
5	74	247.82	30.82	54.56	333.20	57.30	275.90

green of the old leaves disappeared from the margins first, then the le leaves became yellow and dropped from the plant. The process ated itself until there was not nitrogen enough left to give colour to her leaf, when a pale green or even a yellow leaf was formed. The le appearance of the plants was very characteristic.

II. *Relative percentages of nitrogenous compounds in the various s of the soybean and cowpea at definite periods of growth.* — Determi- ons of total, soluble and insoluble nitrogen were made on the dry ter of plants grown under specially controlled conditions. Total

TABLE IV. — *Analysis of nitrogen in soybeans (mgms per jar of 5 plants).*

Harvest	Part of plant	Insoluble nitrogen	Total soluble nitrogen	Nitrogen distilled with Na OH	Nitrogen ppted by phospho tungstic acid	Other soluble nitrogen	Total nitrogen
1	top	61.52	24.39	—	4.16	20.23	85.91
	root	8.90	5.00	—	0.85	4.15	13.90
	nodules	15.72	11.61	—	3.54	8.07	27.33
2	top	135.15	37.99	—	8.11	29.88	173.14
	root	15.49	5.67	—	0.48	5.19	21.16
	nodules	32.83	16.03	—	9.66	6.37	48.86
3	top	146.79	140.12	—	25.63	114.49	286.91
	root	27.03	16.42	—	0.93	15.49	43.45
	nodules	47.95	35.00	—	18.55	16.45	82.95
4	top	183.35	134.26	17.86	25.96	90.44	317.61
	root	20.14	12.93	2.49	0.85	9.59	33.07
	nodules	31.77	27.27	2.38	15.35	9.54	59.04
5	top	151.08	95.32	12.02	29.31	53.99	247.00
	root	21.55	14.38	1.34	1.38	11.66	35.93
	nodules	29.23	27.21	2.00	12.13	13.08	56.44

nitrogen was estimated by the Joldbauer method ; insoluble nitrogen presented that part left undissolved after prolonged shaking with wat soluble nitrogen was divided into the nitrogen precipitated by phosp tungstic acid, the nitrogen in the filtrate from this precipitate and a furt fraction obtained by distilling the water soluble nitrogen with sodi hydroxide. Results are given in Tables III and IV.

The experiments were repeated with soybean and with cowpeas a the following conclusions were drawn :

(1) The total nitrogen determinations show that about 74 per c of the nitrogen of the cowpeas and soybeans at the time of harvest is the tops, while the remainder is distributed between the roots and nodules. In the earlier periods the roots contain the larger part wl later they contain much the smaller part.

(2) The percentage of soluble nitrogen in soybeans and cowpe varies with the different parts of the plant and with the period of grow In these experiments the soluble nitrogen, as an average, constituted the tops about 45 per cent of the total nitrogen ; in the roots 34 per cen in the nodules of the soybeans 1 per cent. and in the nodules of the co peas 34 per cent.

(3) Phosphotungstic acid usually precipitates some form of nit

1 In some cases the amounts precipitated vary widely, while in ers the agreement is close. In these series the nitrogen precipitated phosphotungstic acid averaged in the tops of both soybeans and wpeas about 12 per cent of the total nitrogen; in the roots 5.5 per cent; the nodules of the soybeans 1 per cent and in the nodules of the cowpeas per cent.

(4) Other forms of soluble nitrogen than those precipitated by osphotungstic acid and sodium hydroxide occur. In these series they astitute an average in the tops of both soybeans and cowpeas about 68 r cent of the soluble nitrogen; in the roots 77 per cent; in the nodules the soybeans 89 per cent, and in the nodules of the cowpeas 53 per cent.

(5) Fixation takes place at a very early period in the growth of the edling - sometimes within 14 days. It is rapid in some cases, especially th cowpeas.

(6) Plants grown under the conditions of these experiments contain mmonia, nitrites or nitrates, as measured by the most accurate che-cal methods.

-The Effect of Heavy Dressings of Mineral Salts on the Development and Structure of Plants. — WARNEBOLD, H. in *Landwirtschaftliche Jahrbücher*, Vol. 49, No. 2, pp. 215-231. Berlin, March 25, 1916.

In order to investigate the harmful effects of mineral salts when applied in excessive quantities, plants were grown in pot cultures and as soon as they were past the seedling stage, Wagner P. K. N. salt (containing 8.3 per cent of nitrogen, 26.8 per cent of potash and 17.5 per cent of phosphoric acid) was added to the pots in successive dressings which were continued even after injury to the plants had been observed. The plants were then left in the pots another few weeks before being removed for examination—anatomical and morphological. The actual amount of salts applied was not determined accurately as the object was merely to injure the plants by over manuring. An ordinary garden soil was used in all cases but one *i. e. Helianthus annuus* which was cultivated in silver sand fed with nutrient salts. Controls fed so that normal development could take place were grown in all instance.. The plants selected for the trials were: *Cucurbita Pepo, Helianthus annuus, Raphanus caudatus, Atriplex hortensis, Fagopyrum esculentum, Phaseolus vulgaris nanus, Borago officinalis, Datura Stramonium, Tropaeolum majus, Rumex alpinus.*

The results showed that the critical or harmful dose of Wagner salt varied with the species of plant. Their order of sensitiveness was as follows: *Atriplex, Cucurbita, Datura, Helianthus, Tropaeolum, Rumex, Raphanus, Borago, Fagopyrum.* Also the amount of injury done varied with individuals and with the degree of humidity in the air, though no generalisations can yet be made with regard to the latter observation.

Leaving aside leaf modifications it may be said in a general way that large doses produced similar results in all the species employed. Normal development was always checked, and the plants were all more or less injured. It should be pointed out, however, that with *Cucurbita, Phaseolus* and *Datura* growth was at first stimulated, especially leaf growth,

but that this ceased after the first few applications of salts. Stem dev lopment both as regards length and thickness was retarded, but the low internodes were not shortened to the same extent as the upper ones, pr bably owing to the fact that the plant was less unhealthy in the early tha in the later stages of its life. *Raphanus* stems were less straight, the a gles were more marked at the point of attachment of each leaf. As a r flowering and side branches behaved exactly like the main stem, b in *Phaseolus* the branches were larger in proportion. In all cases bo stem and branches were greener than in control plants. The time of flow ing varied with different plants, the flowers being always dwarfed.

While the development of the lower leaves was usually normal, t growth of the upper ones was poor. Leaf blades and petioles were affe ted, leaf blades being frequently bent and twisted. The leaves were al darker green in the initial stages, but this difference gradually fad away. Stomates were smaller than in normal plants. The root syste was stunted by large doses of mineral salts

Anatomical examination revealed the following differences betwe normal and injured plants: In the stem, the cortex cells were smalle the chlorophyll content was higher; the formation of starch, tannin a oxalate was less active. In the leaves the same differences were observe the leaf-blades were also thicker and while the smaller size of all cells w noticeable it was especially marked in the epidermis and in the palissa tissue. *Raphanus* besides containing more chlorophyll also had larger chr mophores.

In a small number of trials, the pots were lixiviated after a certa time to remove the excess of salt and the plants were allowed to devel under normal conditions. Recovery occured in direct proportion to t amount of injury which the plant had suffered.

1068 – **Nitrogen Requirements of the Olive Tree.** — PETRI, L. in *Atti della R. Accademia Economico Agraria dei Georgofili di Firenze*, Vol. XCI,V, pp. 138-147. Florence, July 1

The writer has shown in previous investigations on *Olea europea* that all members of that species, wild or cultivated, growing on poor or ric soil, invariably bear a certain number of flowers in which the ovary is n completely differentiated and that imperfect flowers such as these fa to fruit. In normal plants the cause of the abortion lies with the suppl of nitrogenous substances in the flowering branches which is not sufficien to meet the requirements of all the flowers produced. Lack of soil moistu is also an indirect cause, for by injuring both roots and leaves, it interfer with the transpiration current and thus prevents the transport of sufficien nitrates to the flowering branches for the proper development of all ovarie The difference between the nitrogen content of a perfectly fertile branc and that of one bearing nothing but flowers with abortive ovaries h proved to be considerable; while the former was shown to contain fro

(1) PETRI L. Studi sulle malattie dell'olivo. V. Ricerche sulla biologia e patologia d Polivo. *Memoria della R. Stazione di Patologia vegetale*, V, pp. 5-64. Rome, 1914. See also 1915, No. 108.

19 to 2.370 per cent of nitrogen in the dry matter, the latter only con-
ned from 0.724 to 0.924 per cent. The phenomena can also be interpre-
ted as a stimulation to over-production of flowers correlated with a scar-
of nitrogen in the flowering branches.

The present investigations were directed to a further study of the con-
uting causes and more particularly to the part played by the "myco-
ic" rootlets as nitrogen storers. These "mycotropic" rootlets or
lets or endotropic mycorhiza are caused by the presence of a symbiotic
gus in the cortical parenchyma of the root; they can like normal rootlets
orb nitrates from the soil solution by means of hairs; but where
he nitrates absorbed by normal rootlets are passed directly through
cortical parenchyma to the distributing vessels of the central cylin-
the nitrates absorbed by mycorhiza are immediately changed to com-
organic compounds for the benefit of the endophitic mycelium which
s on these substances and on the starch found in the adjoining cells.
A large number of experiments were carried out from which the follow-
results may be summarised:

(1) In a soil containing little organic matter, whenever nitrates were
ied in small quantities, *i. e.* lower than the usual percentage in non-
ured soils, mycorhiza were found in large numbers, their development
ing inversely with the amount of available nitrogen in the soil. Also
was always a proportional reduction in the growth of normal
ets. No nitrate reaction (1) was obtained from the mycotrophic roots
ese cases.

(2) When nitrates were present in quantities up to but not exceeding
usually present in a good non-manured soil, about one third of the
ets were transformed into mycorhiza. No nitrate reaction was ob-
d from the mycorhiza.

(3) When nitrates were present in large quantities, very few my-
za were formed and those few gave a positive nitrate reaction. In
cases the rapidity of growth of the normal rootlets prevented the fun-
nfection to a large extent, and even where the fungus managed to
trate into the root and to develop, the mycorhiza was not able to
and fix all of the nitrate absorbed by the root.

These facts demonstrate the effect of endotrophic mycorhiza on the
trees with regard to the *interception of nitrates* and identical results
been obtained when the nitrogen was absorbed in the form of am-
a. Moreover once the nitrogen has been converted into organic
ounds only a minute portion of it ever goes back into circulation in
ost plant, even when the intercellular hyphae which are rich in albu-
ids are subjected to autolysis or digestion.

The interception of nitrogen must accentuate the ill effects of a poor
n olive trees more especially as in such soils the development of
rhiza is particularly active. Practical trials have shown that on well
ured soils only 30 to 40 per cent of the rootlets are transformed into

[1] Nitrates were tested by the Molisch method. (*Ed.*)

mycorhiza while on a hungry arid soil the number may rise to 98 per cent And the condition of the roots is always reflected in the number of flower with abortive ovaries. Further, where the nitrogen supply is so limited the whole vegetative growth of the olive tree suffers. Sandy soils poor in lime and organic matter and liable to long periods of drought are particularly favourable to the development of mycorhiza, whereas rich calcareous soils stimulate the growth of normal roots.

Experiments were also carried out to determine whether the endoradical mycelium intercepted phosphoric acid. No interference in absorption and transport was observed.

Olive trees whose flowers are almost all sterile do not regain the fertility even when generously manured and this fact would indicate that the flowering branches, after being submitted to a prolonged course of mal nutrition, undergo profound physiological modifications which are irreversible. Further investigations are required to establish whether this change is really complete, or whether the trees would eventually recover with time and treatment. The nitrogenous manures which are specially useful to stimulate the formation of a normal root system are those directly available to the plant and owners of olive groves should be encouraged to dress their groves periodically with such fertilizers.

PLANT BREEDING

1069 – **Correlated Characters in Maize Breeding.** – COLLINS, G. N. in *Journal of Agricultural Research*, Vol. VI., No. 12, pp. 435-453 + tables XLV - LXIII. Washington, D. C. June 19th, 1916.

Two principal methods of breeding can be distinguished, depending on the manner in which selection is carried out :

(1) Selection may aim at the isolation and propagation of desirable types of individuals.

(2) Selection may be directed towards the variation of individual characters, regarding which improvement is required.

With the majority of crop plants the method of selection of types has been by far the most productive, but this method has been very little used in the improvement of maize. Selection has been by characters instead of types.

It has not been clear why the isolation of types of plants has not been a factor in the improvement of maize. Although the differences in the characters are very clear and striking, few breeders have been able to distinguish well defined types of plants within the commercial varieties. If recognizable types exist, it must mean that groups of characters tend to appear together : in other words, the characters are correlated. The extent to which obvious characters are correlated is therefore proposed as a measure of this tendency towards the persistence of types. The experimental results here reported show that in the progeny of a hybrid between two very different varieties of maize, the characters studied, instead of forming coherent groups, are almost entirely independent in inheritance.

In attempting to measure the extent to which types persist by means of correlation coefficients, it is necessary to distinguish different kinds of correlations. For this purpose correlations are here classified as physi-

ysiological and genetic. A method is also proposed by which physio-
gical and genetic correlations may be distinguished. *Physical correla-*
ons, are those in which the relation of cause to effect is evident, that is
say, in which one character is a function of another (for example when
increase of weight is correlated with increased height). *Physiological*
rrelations are those in which two characters are both the result of the
me physiological tendency, as when long internodes in the primary stem
e correlated with long internodes in the branches. *Genetic correlations*
mprise the large residue of correlations, the nature and causes of which
subject to controversy, but which are associated with the method or
chanism of heredity. In order to determine with certainty that a given
rrelation is physiological and not genetic, it would be necessary to de-
nstrate the existence of the correlation in a number of subjects in which
the individuals possessed the same hereditary tendencies with respect
the characters studied. Theoretically this is only possible in asexually
opagated groups. Approximately pure lines can be obtained where
fpollination is possible, so that if correlations are found, they may with
surance be considered physiological. With maize, however, even ap-
oximately pure lines present such abnormal conditions that some other
thod of study must be sought. For this plant it would seem that the
lution of the question might be approached by comparing the degree
correlation in types or varieties having a relatively restricted ancestry
th that in several generations of hybrids crossed among themselves and
rived from two contrasted types. An equally satisfactory method is
compare the degree of correlation in the hybrid of the first generation
h that of the generations obtained by crossing the hybrids among them-
es. If the first generation is all descended from a single cross, its ga-
tic differences should be no greater than those of the progeny obtained
self-pollination.

The hybrid that afforded the data for the present paper was a cross
ween "Waxy Chinese" and "Esperanza", two varieties of maize
arated by a number of definitely contrasted characters. These extreme
es must have been completely isolated from very remote times. The
rid was made at Lanham, Md. in 1908. The plant of Waxy Chinese
d as female parent of the hybrid was grown from the original seed
orted from China. The Esperanza variety belongs to a peculiar type
maize (*Zea Hirta* of Bonafous) that appears to be confined to the table
ds of Mexico. The characters of the two varieties presenting the sharp-
contrast are as follows.

"Esperanza"	*"Waxy Chinese"*
y endosperm	Waxy endosperm.
ching space short	Branching space long.
erect	Tassel curved.
kets of the male inflorescence in whorls of 4 to 5.	Spikelets of the male inflorescence inserted in pairs.
es long.	Glumes short.
sheaths with tuberculate hairs.	Leaf sheaths without tuberculate hairs.
r leaf blades horizontal.	Upper leaf blades erect.
r leaf blades distichous.	Upper leaf blades monostichous.

The large number of well defined characters which differentiate th two varieties rendered this material exceptionally favourable for th study of coherence, by which is meant the tendency for characters associat ed in one parent of a hybrid to remain together in the later generation o the hybrid.

For the study of correlations 11 characters were selected in whic the parent varieties showed little or no overlapping. The correlation coef ficients of all the combinations were calculated, and it was found that, ou of 55 possible combinations, 20 exhibited significant correlations. Ther was not a single case in which the correlation between two character was closer than 0.5, a fact which in itself offers an explanation of the diffi culty of recognizing types in maize.

This lack of coherence of characters in maize, coupled with the fac that in order to maintain a satisfactory degree of vigour diversified ances try must be maintained seems to render the method of isolating type inapplicable to this plant. As an offset to the limitation thus imposed advantage may be taken of the facility with which desirable character derived from different parents can be combined.

Appended is a bibliography of 11 works.

1070 – **Number of Chromosomes and Size of the Nucleus in Some Forms of *An tirrhinum.*** — BRESLAVETZ, L., in *Труды Бюро по прикладной Ботаники* (*Bulletin of Applied Botany*), 9th year, No. 6 (91), pp. 281-287 (English text pp 288-9 Petrograd, June, 1916.

As cytologists rarely have at their disposal pure material of non-l brid origin, and as much importance is attributed to the nucleus and ch mosomes in the transmission of hereditary characters, the number of ch mosomes in pure lines of certain plants and in their hybrids have been termined.

The researches were carried out with pure lines of *Antirrhinum maj A. latifolium* and *A. tortuosum*, and also with hybrids of the first and cond, and the first and third. The cells used were taken from the flow buds, 280, 84, 56, 19, 25 being examined from each variety in the or cited. Thanks to the abundance of material it was possible to obta a large number of nuclei in which the nuclear plate was clearly visible The nucleus and chromsomes are very small, but during the phase of t nuclear plate the chromosomes are far enough apart to be counted easi

Also, the size of the nucleus has been determined during the pha of "synapsis" when the nuclear content gathers itself together at one si The researches of other workers have shown that the difference in the s of the nuclei of different plants is most evident in the sexual cells duri this phase of synapsis, and also that the size of the nucleus may serve a means of morphological distinction between types that are closely relat systematically.

From the data obtained it is concluded that:

(1) The number of chromosomes in the somatic cells of *A. majo A. latifolium* and *A. tortuosum* is the same, i. e. 18.

(2) The number of chromosomes in the hybrid *A. latifolium* × *A.* *jus* is also 18.

(3) The shape of the chromosomes is the same in all the plants stu- d.

The results of the investigations on the size of the nucleus are as fol- ıs:

	Number of nuclei measured	Average diameter	
A. latifolium	120	7.01 μ	= 100
A. majus	75	6.84 μ	= 97
A. tortuosum	45	6.01 μ	= 85
A. majus × *A. tortuosum*	96	6.04 μ	= 86

These results show that :

a) The size of the nucleus in the pollen mother-cells at the phase ynapsis is almost the same in *A. latifolium* and *A. majus*, while the eus of *A. tortuosum* is considerably smaller.

b) The difference between the size of the nuclei in *A. tortuosum* in *A. majus* and *A. latifolium* finds a parallel in the external morpho- al character of these types.

c) The nuclei of the hybrid *A. majus* × *A. tortuosum* are the same as those of *A. tortuosum*.

The differences in the size of the nuclei in these varieties of Antir- ım lead one to suspect other morphological differences may exist een the nuclei, though they escape detection for the time. It might investigation to examine various other plants in which the shape umber of the chromosomes are the same, but in which the dimen- of the nuclei differ.

he article is followed by a résumé (pp. 294-309) of present-day theories e nucleus as transmitter of hereditary characters. A bibliography publications is appended.

A Case of Variations Observed in the Potato in Holland. — VAN LUIJK in *Cultura* h year, No 332, pp. 124-127. Wageningen, 1916.

mother plant of the variety Leeuwsche blauwen known by the num- was isolated in 1911 for the purpose of investigations on "mosaic e". Among its direct descendants a perfectly healthy individual ily appeared in 1912, which was distinguished from the rest of the by the greater rigidity of its stem, its heavier weight (2.9 lbs. r), by the colour of its tubers. (deep violet instead of violet), and by ngated oval shape of its tubers. This is an interesting case of varia-

ıe tubers from the varying individual were planted in pots, and 3 95 plants were obtained which naturally grouped themselves into visions :

1) 76 plants susceptible to mosaic disease. Some of these resem

bled the mother plant 07 in appearance and size and others exhibited m or less variation in shape and colour.

2) 17 healthy plants with violet tubers.

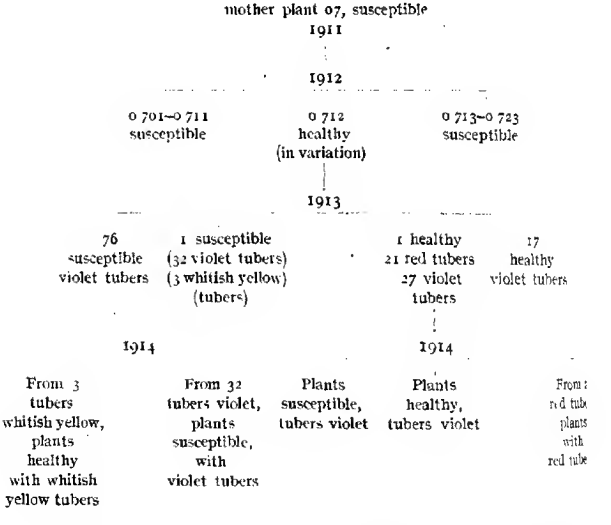
3) 1 plant possessing normal tubers, with the exception of three a whitish yellow colour. The latter were planted, and in 1914 produc pure descendants with whitish-yellow, healthy tubers.

4) 1 almost healthy plant, showing evident marks of variatio violet petioles: glabrous and shining leaf blades, very elongated; grow rapid and exuberant; tubers of various shapes — normal violet and rou ded, deep violet and rather oval, red and very elongated. These we all planted separately in pots, and in 1914 the crop showed that

a) the red colour is transitted by the red tubers to their descen dants, which are more or less liable to "mosaic disease".

b) the violet tubers produce plants bearing violet tubers, but the plants are clearly divisible into two groups — healthy and susceptible.

From these data the following genealogical tree may be built up:



This biological study is being continued with a view to establishin character and number of the "determinant" elements in the appea of new characters.

This case of variation is of some scientific importance and is al much practical value, as it demonstrates the possibility of isolating fixing a variety of potato which is healthy and not susceptible to m disease.

Experiments on Crossing Two Varieties of Sunflower (*Helianthus annuus* × *H. agrophyllus* A. Gray) to obtain a type resistant to rust, in Russia. — SAZYPEROV, F. A., in *Труды Бюро по прикладной ботанике*. (Bulletin of Applied Botany). Year IX, No. 5. (90) pp. 207-227; (English text pp. 228-241), 1 plates. Petrograd, May 1916.

In the breeding of sunflowers for oil great importance is attached to their resistance to several hostile agents, of which the chief are *Homeosoma nebulella* Hb., *Orobanche cumana* Wall., and *Puccinia Helianthi* Schr. There are types of Sunflower which are resistant to the first or second enemy (for example the group of "cuirassed" (1) Sunflowers, and among them the Karzinskij, which is not attacked by *Homeosoma nebulella* Hb., and the Zelenka which, besides, resists *Orobanche cumana* Wall). but we do not yet possess an oil Sunflower capable of resisting the rust, the most redoubtable enemy of all. *Puccinia Helianthi* attacks all types, that of *H. annuus* L. as well as that of *H. debilis* Nutt; *H. agrophyllus* A. Gray, an ornamental plant, is a solitary exception.

The experiments were carried out at the section of Voronezh of the Bureau of Applied Botany of the Ministry of Agriculture. The preliminary investigations carried out by the author on several varieties of sunflower had established the fact that *H. Agrophyllus* A. Gray, was endowed with certain resistance to rust; in 1912, one plant of this was not attacked by rust, and in 1913, a very wet year, a good number of plants escaped the disease. For this reason, a cross was made between (1) a variety of cuirassed Sunflower (var. Ugolnij) resistant to *Homeosoma nebulella* and to *Orobanche cumana* Wall and selected from one of the plots of sunflowers not infested by Orobanche, and (2) a *H. agrophyllus* received from Germany. The choice fell upon the latter because, unlike other seeds obtained from Italy and Moscow, it was not attacked by rust.

The mother plant was *H. annuus* and the male plant *H. agrophyllus*; their characteristics are as follows:

Helianthus Annuus L. var. *Ugolnij*.	*Helianthus Agrophyllus* A. Gray.
a) Stem not branched	Stem much branched from the base.
b) Average height of stem 165 cm (= 66 ins.).	Average height of stem, 175 cm (= 70 ins.).
c) Stem covered with thick and rigid hairs.	Stem covered with soft whitish hairs
d) Upper part of the stem clothed with longer and softer hairs.	Upper part of the stem clothed with a thick down of a silvery white colour
e) Middle leaves heart-shaped.	Middle and especially upper leaves elongated, or lanceolate.
f) Leaves green and wrinkled	Leaves whitish, felty on both sides, and soft
g) A single large inflorescence.	Several small inflorescences the largest measures 7-8 cms (= 2.8 - 3.2 ins.)
h) Receptacle flat, slightly convex.	Receptacle very convex.
i) Ray florets yellow (var. *flavus*).	Ray florets dark yellow (var. *vitellinus*).
k) Disc florets dark yellow (var. *vitellinus*)	Disc florets brown (var. *brunneus*).

(1) The "cuirassed" sunflowers distinguished by a special structure of their fruit (achene) in the pericarp of which, between the corky layer and that of sclerenchyma there occurs specially thickened layer.

11) Achenes large.	Achenes small.
12) Achenes of type Zelenka (2)	Achenes of type Gajdukovskij (2).
13) Achenes not spotted.	Achenes spotted.
14) Flowering rather late.	Flowering very late.
15) Badly attacked by rust.	Not attacked by rust.

The individuals of the first generation were not uniform and showed several degrees of intermediate types which was to be anticipated, seeing that the mother plant was heterozygous. Nevertheless, it was the character of the male plant which predominated, especially in the structure of the leaves, and in the branching. As for the resistance to rust, it turned out that all the plants with green leaves, that is to say those which resembled the mother plant, were very strongly attacked by the parasite. The rust also attacked a small part of the plants with grey-green leaves, i. e. those intermediate in structure between the female and male parents. All the other plants, with silvery-grey leaves resembling those of the male parent, were not subject to rust. The fact that 2-3 of the individuals were resistant to rust showed that the investigator was on a good track, and although among these individuals there was not one that was interesting from the agricultural point of view the researches were followed up in 1915.

For the second generation the observations were made in 307 individuals reproduced from the seeds of plants which had not been attacked by rust. In this generation a considerable number of types were obtained in which were combined, in various proportions, the characters of one or the other ancestor. Though it was not possible to find any individual presenting a pure reproduction of the characters of its forebears, yet types were often observed that were very close to one of the ancestors and only differed from it in one or two characters. At the same time a considerable number of individuals were observed which occupied an intermediate position between the two original parents, as had already been noticed among the individuals of the first generation. Neglecting other characters of the hybrids of the second generation, their behaviour with regard to rust may be indicated. It must be remembered that the year 1915 was most exceptional for the spread of this disease. The heavy summer rains encouraged the development of the parasite so that by mid-August nearly all the leaves of the Sunflower were withered in a very large number of plants. But observations made in this year, so favourable to rust, showed that $^1/_4$ of the hybrids resisted the disease. The distribution, with reference to their structure, of the leaves which were attacked by rust and those which were resistant to it, was as follows :

(2) The achenes of the sunflower Zelenka are characterised by the presence of a cuticose layer and by their striped coats, while in those of the sunflower Gajdukovskij there is also a special pigment soluble in water which is localised in the corky layer. See Bulletin of Applied Botany, No. 4-5 (79) pp. 574-576. Petrograd, 1915.

	Leaves attacked by rust	Leaves not attacked by rust
a) Green leaves	215	6
b) Grey-green leaves	8	64
c) Silvery-grey leaves	3	7
	226	77

It is seen from this table that the plants affected by the disease had rough green leaves, while those which were resistant had grey-green leaves of the intermediate type or silvery-grey leaves of the male type. If it be considered that only the seeds of those hybrids were used which were not attacked by rust the preceding year and which, in most cases, had grey-green leaves, and also that one is depending on the characteristics of the second generation, it must be recognised :

(1) that the resistance to rust is a recessive character.

(2) that it fully obeys the Mendelian law.

(3) that between this characteristic and the structure of the leaves here does not exist an absolute correlation, since the immune plants are found in all the classes (*a*, *b*, and *c*).

In the second generation there are types which may also have an interest from the agricultural standpoint, and which will serve for the future experiments that it is proposed to make with a view to obtaining a form of sunflower resistant to rust and useful for agriculture. Meanwhile, these initial experiments have given a result of practical importance, namely that by crossing appropriate parents a variety of Sunflower can be obtained which is resistant, at one and the same time, not only to *Homeosoma nebulella* Hb., and to *Orobanche cumana* Wall., but also to *Puccinia Helianthi* Schr.

CEREALS AND PULSE CROPS

973 - **Results of 20 Years Experiments on Maize at the Agricultural Experiment Station, Ohio.** — WILLIAM, C. G. and WELTON, F. A. in *Bulletin of the Ohio Agricultural Experiment Station*, No. 282, pp. 71-109, 9 fig. Wooster, Ohio, 1915.

1) Comparing a five year rotation system with the continuous growing of maize, the former has given an increase of 13 to 14.79 bushels per acre in spite of the heavier use of manure and fertilisers under continuous culture. The five year rotation consisted of maize, oats, wheat, clover and timothy, clover being the fourth year, and timothy, the fifth, both being sown together in the wheat. Comparing a five year with a three year rotation (maize, wheat, clover) the latter has given an increase of 6 to 8.39 bushels per acre. Comparing a three year rotation with continuous cropping, with fertilisers used in either case, the yield of corn from the former is 127 per cent greater, than in the latter, as shown in Table I. The results for the five year and three year rotations are given for an average of 20 and 12 years respectively.

2) The use of phosphorus alone, in the form of acid phosphate, has increased the yield of corn 8.28 bushels per acre. The use of manure alone has increased the yield 31.27 bushels per acre as an eight year average.

The use of acid phosphate and manure has increased the yield 40.58 bushels, thus leaving 9.31 bushels to be credited to the acid phosphate.

3) On such acid soils as are found on the Station farm at Wooster, one ton of burned lime, or two tons of ground limestone, applied once in 5 years, has increased the yield of corn on an average 7.35 bushels per acre on the fertilised plots and 8.25 bushels per acre on the unfertilised plots. Taking into consideration all the crops of the rotation, the application of lime has been worth, on the average, £ 2 18 *s* 0 *d* (0 $ 14.21) per acre per rotation, the cost of the lime being £ 1 1*s* 0*d*. ($ 5).

4) Comparing very deep ploughing (15 ins) with ordinary ploughing (7 ½ ins) and with subsoiling (carried out by running an ordinary subsoil plough in the bottom of the ordinary furrow for an extra depth of 7 ½ inches), the 5 year average gain for subsoiling has been 2.32 bushels per acre and for the deep ploughing, 0.43 bushel per acre, compared with the quantities obtained with ordinary ploughing.

5) Plantings of maize made at Wooster from May 4 to 10 have given larger yields of shelled corn per acre than the plantings of other dates though the moisture content and the shrinkage have been lower for the plantings made from April 24 to 29. Of the plantings of the latter dates 78.62 lbs of ears as weighed in November have been required to equal a bushel of shelled corn in April, while of the planting of June 2 to 6, 91.95 lbs. of ears have been required. The variety of corn and all the conditions of growth except date of planting have been the same.

6) Where the distance between rows (42 ins.) and the number of plants per acre (12 446) have been the same, one plant every twelve inches has outyielded 3 plants every 36 inches (in hills) by 4.55 bushels per acre. The produce obtained from isolated plants and from those grouped in hills of 2, 3 and 4 respectively was: — grain, 46.88; 46.28; 42.33; 42.85 bushels per acre; stems (stover), 2 827; 2 417; 2 168; 2 180 lbs. per acre.

7) With hills 42 inches apart each way, the maximum yield of shelled corn, as a 10 year average, has been secured from 4 plants per hill or 14.220 plants per acre.

8) Nine years tests of deep (4 ins.) as compared with shallow (1 ½ ins) cultivation show an average gain of 4 bushels per acre in favour of shallow cultivation. The average crops have been respectively: — grain — 56.4; 60.4 bushels per acre; stems — 2 691, 2 874 lbs. per acre.

9) Two years' tests of three late cultivations of corn (in July and August) with a one-horse cultivator, after the ordinary cultivation has been carried out with a two-horse implement (five cultivations in June and early July) show an average gain of 3.44 bushels per acre for late cultivation.

10) A 10 year average variation of 6.25 bushels per acre has been found in varieties of corn well acclimatized to the locality where tested. A variation in yield of 34.29 bushels per acre has been found in varieties grown and sold for seed within the state of Ohio.

11) A comparison of ears varying 2.44 inches in length, on the average shows a difference in yield of only 1.39 bushels per acre, as a

TABLE I. — *Continuous vs. Rotation Corn. Twenty Years Work.*

System	Treatment	Applied per acre		Av. yield per acre-bushels				Average yield for 20 years
		Per crop	Per 5-years	1st period	2nd period	3rd period	4th period	
Continuous	None	—	—	26.26	16.76	10.43	8.44	15.47
Rotation (1)	None	—	—	31.89	30.82	131.04	20.31	28.95
Continuous	Manure	5 tons	25 tons	43.13	40.11	34.62	30.22	37.02
Rotation (1)	Manure	8 tons	16 tons	40.73	49.52	59.75	55.83	51.81
Continuous	Commercial fertiliser	250 lbs	1 250 lbs	38.86	39.09	28.00	26.83	33.19
Rotation (1)	Commercial fertiliser	320 lbs	985 lbs	35.78	49.54	53.91	44.10	46.49
Rotation (2)	Manure	8 tons once in 3 years on corn						(3) 60.20
Rotation (2)	None	Average of 8 unfertilized plots						(3) 35.19

(1) 5-years rotation. — (2) 3-years rotation. — (3) Average for 17 years.

TABLE II. — *The Value of Manure and Phosphorus. Three-year Rotation.*

Treatment	Lbs per acre	Cost	Average yield of corn per acre-Bushels		Average value of increase per acre of all crop of the rotation	
			Period 1897-1905	Period 1906-1913	Period 1st	Period 2nd
		s. d.			s. d.	s. d.
Stall manure	16,000	—	57.13	64.14	95 7	121 8
Stall manure	16,000	9 4	62.28	73.45	157 0	189 6
Acid phosphate	320					
Stall manure	16,000	6 8	61.97	72.05	148 0	155 11
Floats	320					
None :						
Average 8 unfert. plots	—	—	36.99	32.87	—	—

Year average — a difference no greater than might have been expected had the seed used been identical — while there is a slight decrease in length of ear in the shorteared strain, it has not materially affected the yield.

12) As a 9-year average, tapering ears have excelled cylindrical ears in yield by 1,65 bushels per acre.

13) Eight years continuous selection for bare, as compared with filled tips shows an average difference of 0.34 bushel per acre in favour of filled tips.

14) Comparing rough with smooth-dented ears (in variety "Clarage") the 7-year average yield favours the smooth type by a gain of 1.76

TABLE III. — *The Effect of Lime on Corn, Grown on Acid Soils, and the Value of Lime to the Entire Rotation. Average of* 12 *years.*

Treatment (Fertilizers per acre for one rotation of 5 years)	Yield of corn per acre-Bushels		Value per acre of all crop of the rotation	
	Unlimed	Limed	Unlimed	Limed
			s. d.	s. d.
I. Without nitrogen.				
Phosphorus, 20 lbs in acid phosphate . .	36.13	43.64	282 6	340 10
Phosphorus, 20 lbs; potassium, 108 lbs, in muriate of potash	43.86	51.68	317 10	384 8
II. Nitrogen, 38 lbs, with phosphorus, 30 lbs, and potassium 108 lbs.				
Nitrogen in nitrate of soda.	48.85	56.29	365 8	435
Nitrogen in sulphate of ammonia	45.80	57.68	333 6	433
III. Nitrogen, 76 lbs in nitrate of soda, with phosphorus, 20 lbs, and potassium, 108 lbs.				
Phosphorus in acid phosphate	49.06	55.73	390 11	429 1
Phosphorus in bone meal	45.53	52.59	365 0	420
Phosphorus in basic slag	48.71	52.07	384 10	402
IV. Yard manure, 16 tons, estimated to carry nitrogen, 144 lbs.				
Phosphorus, 48 lbs; and potassium 112 lbs.	56.02	62.71	412 10	479 4
Average of unfertilized plots	25.96	34.21	205 10	255 1

TABLE IV. — *Influence of the Time of Sowing on the Yield, Moisture Conten and Loss of Weight.*

	Date of sowing				
	April 24-29	May 4-10	May 14-17	May 25-28	June 2-6
Yield per acre, (average of 6 years), in bushels	63.86	68.49	67.07	54.87	44.32
Moisture content, (average of 6 years)	23.73 %	25.08 %	25.93 %	29.13 %	33.52 %
Weight of grain obtained in April from 50 lbs ears as weighed in November, in lbs. (average of 5 years).	35.60	34.55	33.90	31.65	30.45

bushels per acre. There is thus no foundation for the opinion, so widespread among growers, that lack of marked roughness is an indication of shortening of the kernels, reduced yield and deterioration in general.

15) Seed ears averaging 88.16 per cent grain have given a 6-year average yield of 64.64 bushels of shelled corn per acre, as compared with a yield of 65.06 bushels from ears averaging 76.38 per cent of grain.

16) A comparison of kernels from the butt, middle and tip portions of ears shows only 0.57 of a bushel difference in yield, as a 9-year average, and no difference in maturity or any important character.

17) Seed ears having 14,16 and 18 rows of kernels have been compared for 5 years. The 14-rowed ears led slightly in yield at Wooster and Germantown; the 16-rowed ears at Carpenter.

18) While the height of plant and ear varies with the season, selecting for high and low ears within a variety has resulted in changing very materially the relative height of ear and also the time of maturity. Low ears are associated with earliness. The comparative yield has not been reduced by selection for low ears.

19) Seed corn grown on rich, as compared with poor soil, and one plant per hill, as compared with five, though larger and apparently of better quality, has not given any larger yield, on the average, than the smaller ears grown under the poorer conditions.

20) The principal causes of barren plants are variations in season, in fertility, and in time and rate of planting. Such variations in conditions of growth have increased the amount of barrenness 200 to 2 000 per cent.

21) The cultivation in separate rows of grains from the same ear ("ear-row" tests) and the suhsequent crossing of the best ears in isolated breeding plots show possibilities of increasing the yield of corn 5 to 10 bushels per acre, but it seems difficult to go much beyond this amount.

22) Of 13 first-generation crosses grown beside both parents, only two exceeded in yield the better parent variety by more than 2 bushels per acre.

23) A 4-year average gain of 3.9 hushels of shelled corn per acre has resulted from the use of the individual ear germination test. At 2*s* *d* (50 cents) per bushel for corn, this is a return of £ 1 7*s* 0*d* ($6.50) per hour for testing.

24) Experiments in thinning corn show a 4-year average gain of 8.47 bushels per acre in the case of untested seed and 6.31 bushels for tested seed. The average time required for thinning an acre of corn has been 5.7 hours.

25) As an average of 6 years' tests corn reached its maximum shrinkage August 1st. Based on shrinkage alone 2*s* 7¼ *d* (62.47 cents) for pounds of ear-corn on August 1st is equivalent to 2*s* 1*d* (50 cents) on November 1st. While midseason and late varieties had 24.29 and 31.04 per cent of moisture, respectively, on November 1st, on August 1st they carried 10.08 and 10.69 respectively.

4 - **Effect of Sulphur in the Cultivation of the Potato ; Experiments in Chili.** — OPAZO G. R. in *El Agricultor*, No. 109, pp. 129-130. Santiago de Chili, June, 1916. STARCH CROPS

It has been shown that it is not enough to add sulphur to any or every to obtain good results. As proof may be cited the opinion expressed Boullanger in his communication of July 1912 to the Paris Academy of

Science: "Sulphur stimulates the active propagation and the reducing action of bacteria, which break up the complex nitrogenous compounds into ammonia. It also acts on nitrifying organisms". From this it is concluded nitrogenous matter must first be present in the soil.

Experiments made in 1914 at the farm Valparaiso en Nuñoa were carried out under the following conditions. Rows 54 feet long and 32 inches apart were marked out on soil rich in organic matter; the seed, bought at San Carlo, was disinfected with formalin, as it was of inferior quality. The experimental field, divided into 4 plots, each 51 square poles in area, gave the following results.

Number of plot	Treatment (Per plot)	Crop of tubers per acre (bushels)
1. (Control)	—	236
2.	Sheep's manure, well decomposed, 1129 lbs.	243
3.	Sheep's manure, 1129 lbs. + Sulphur 70.5 lbs	381
4.	Sulphur, 70.5 lbs.	408

The application of sulphur alone increased the crop of tubers by 72 p cent the action of the sheep's manure being negligible, as the soil was ri in organic manure. The experiment was repeated the following ye on a field which had carried lucerne for several years, so that it was suf ciently supplied with organic matter. Corahila potatoes were planted a sulphur was applied at the rate of 4 ½ lbs. per row of 54 feet. The expe ment aimed at studying simultaneously the action of sulphur and of chal but only the results from the plots with and without sulphur are cited, follows:

Area of plots	Square poles	Crop of tubers bushels
Plots *with* sulphur	701	1468
Plots *without* sulphur	345	447

In this experiment the crop of tubers was increased by 65 per cent l the action of sulphur.

Conclusion. The author advises the use of sulphur on soils rich nitrogenous matters or in countries where the requisite quantities of she or cow manure can be obtained.

The sulphur can be selected at the lowest price, as it is not necessa for it to be sublimed. In Germany iron pyrites containing the proper qua tity of sulphur has been used, and the same results obtained as with t application of purified or sublimed sulphur.

1075 – **Experiments on the Cultivation of Meadows on Peat Soils in Russia.** — Fomin V. A., in *Сельское Хозяйство и Лѣсоводство* (Agriculture and Sylviculture), Vol. CCLI, Year LXXVI, Petrograd, June 1916.

The experiments were carried out in 1914 and 1915 in the province of Toula according to the following plan:

1) Harrowing with harrow of different types.

2) Harrowing and manuring.

3) Deep ploughing manuring and seeding with grass seeds after the removal of a preparatory crop.

4) Deep ploughing, manuring, chalking and seeding with grass seeds after the removal of preparatory crop. Nearly all the experiments were repeated on three plots of 72 sq. poles each. The manures applied were 1.9 cwt. basic slag per acre and 66 lbs of potash salts per acre. For chalking, each acre received 9 cwt. of chalk. With regard to the seeding, each acre received 11 lbs. per acre of the following species *Trifolium pratense* L., *T. hybridum*, *T. repens*, *Phleum pratense* L., *Festuca pratensis* Huds., *Poa pratensis* L., *Poa trivialis* L., *Cynosurus cristatus* L., *Bromus inermis* Leyss. and *Lolium perenne*: in some cases *Agrostis vulgaris* With. and *Dactylis glomerata* L. were added. The first year, for various reasons, the experiments were not successful, especially with a preparatory crop. The results of the second year's experiments are summed up in the following Table.

Experiments on the Cultivation of Peat Bogs.

	Average percentage increase over the same area (3.46 sq. yds.)			Percentage composition of species			
				On the field		In hay	
	In the number of plants	In the height of plants	In the bulk of the vegetation in the green state	Species of little use or useless	Useful species	Species of little use or useless	Useful species
	per cent	per cent	per cent	per cent	per cent	per cent	per cent
ntrol	—	—	—	93.2	6.8	97.0	3.0
rrowed	32	34	56.8	86.1	13.9	89.3	10.7
arrowed and manured	113	66	290.4	62.0	38.0	74.6	25.4
arrowed, manured and seeded	234	88	347.0	37.6	62.4	37.0	63.0
arrowed, manured chalked and seeded	230	101	438.0	45.0	65.0	29.3	60.7
oughed deeply, manured and seeded	232	108	637.7	28.0	72.0	20.5	79.5
oughed deeply, manured, chalked and seeded	242	121	650.4	26.0	74.0	15.5	84.5

From the results obtained the following conclusions are drawn:

1) By a simple harrowing the crop of forage is increased on the average by 56.8 per cent.

2) Harrowing and manuring give an increase of nearly 300 per cent

3) Harrowing, manuring and seeding give an increase of 350 per cent on the crop, causing at the same time a considerable modification in the flora of the cultivated peat bogs.

4) Complete cultivation, with deep ploughing, manuring and seeding gave an increase in crop of 600 to 900 per cent.

5) Experiments with weeded areas gave results of little promise though not absolutely discouraging.

6) The increase of crop which follows the cultivation of peat bogs is determined by the following factors:

a) Increase in the nutritive capacity of the soil, which results in an increase in the number of plants per unit area and also in better development of the individual plants.

b) The light and worthless species disappear from the hay and are replaced by more valuable grasses and leguminous plants which are heavier and more tufted.

7) The importance of the cultivation of peat bogs is therefore not only quantitative but also qualitative, because with improved cultural methods the poor and useless species of the flora disappear very rapidly from the bogs and are replaced by useful species which, with favourable soil conditions, show good development of aerial parts as well as of underground parts.

With regard to the economic side of the experiment, the expenses incurred in the cultivation of peaty meadow were completely repaid during the second year, cost of drainage etc. being taken into consideration.

1076 - **Chemical Composition of Alfalfa as Affected by Stage of Maturity, Mechanical Losses and Condition of Drying.** — SWANSON, C. O., and LATSHAW, W. I. (Chemical Department, Agricultural Experiment Station, Manhattan, Kansas), in *The Journal of Industrial and Engineering Chemistry*, Vol. 8, No. 8, pp. 726-729. Easton, Pa., August, 1916.

Experiments on the chemical composition of lucerne (alfalfa) have been carried out for two years running, 1914, with a moderately dry summer and 1915, with an unusually wet season. The lucerne to be analysed was cut from duplicate and triplicate 0.1 acre plots, at the time of budding, one-tenth bloom, full bloom and at seed formation. As soon as cut, a sample was taken and spread in an attic room to dry. When the hay cut in the field was dry enough to stack it also was sampled, and the sample was taken to the same attic room. When the green sample was partially wilted a subsample was taken, and the proportion of leaves to stem was determined on an air-dry basis. Samples of alfalfa cut at the same stages of maturity were also obtained at the time of feeding.

The analytical figures show that lucerne cut at the time of budding contains a maximum proportion of ash and crude protein, together with a minimum of crude fibre and nitrogen-free extract. The latter increase

Calculated on a 10 % moisture basis.

	Stage of maturity	Ash	Crude protein	Pure protein % of crude protein		Crude fibre	N-free extract	Ether extract
				in sun	in shade			
	1914	lbs	lbs	per cent	per cent	lbs	lbs	lbs
Whole crop	Bud	817.01	1 483.66	86.09	71.96	1 815.57	2 674.92	186.75
	1/10 bloom	664.35	1 235.92	83.50	74.55	1 734.61	2 399.51	251.00
	Full bloom	534.61	967.17	86.04	80.55	1 589.52	2 167.56	218.50
	Seed	331.40	674.55	84.95	84.00	1 310.24	1 786.94	134 82
Leaves	Bud	487.06	1 145.44	75.79		582.41	1 501.87	147.07
	1/10 bloom	405.43	946.55	78.21		556.12	1 422.32	167.22
	Full bloom	281.07	693.07	80.98		429.39	1 258.41	159.95
	Seed	182.21	423.12	82.88		286.00	804.76	93.93
Stems	Bud	329.95	338.22	68.62		1 233.16	1 173.05	39.68
	1/10 bloom	258.92	289.37	73.08		1 178.49	977.19	83.78
	Full bloom	253.54	274.10	74.24		1 160.13	909.15	58.55
	Seed	149.19	251.43	79.64		1 024.24	982.18	40.89
	1915							
Whole crop	Bud	878.31	1 710.30	75.92	64.41	2 303.80	2 683.76	143.25
	1/10 bloom	1 066.34	1 767.20	74.22	66.65	3 376.50	3 516.62	199.52
	Full bloom	1 165.08	2 088.10	75.78	70.79	4 109.71	4 338.46	269.99
	Seed	792.31	1 419.88	75.55	75.67	3 094.71	3 329.07	189.25
Leaves	Bud	436.63	1 121.35	72.30		639.95	1 391.65	107.21
	1/10 bloom	484.55	1 120.28	74.17		821.54	1 522.86	149.80
	Full bloom	501.25	1 136.69	75.20		796.69	1 891.82	180.29
	Seed	340.40	796.66	77.16		619.83	1 359.82	111.55
Stems	Bud	441.68	588.95	56.86		1 663.85	1 292.11	36.94
	1/10 bloom	521.79	646.92	58.05		2 554.96	1 993.76	49.72
	Full bloom	603.83	951.41	63.13		3 313.02	2 546.64	89.70
	Seed	451.91	623.22	75.07		2 474.88	1 969.25	77.70

as the maturation of the plant progresses, while the ash and crude protein decrease. The total amount of any or all nutrients produced per acre depends to a large extent on the yield, as was shown by the fact that in 1914 the greatest amount of nutrients was obtained in the bud stage, while in 191[illegible] the full bloom gave the greatest amount. The leaves and stems differ i content of ash, ether and nitrogen free extract, but the greatest differenc is in the per cent of crude protein and crude fibre. The leaves contain over 2 ½ times as much protein as the stems, while the stems contain ove 2 ½ times as much crude fibre as the leaves. As in harvesting and han dling lucerne there is a large loss of leaves, the hay comes to be richer in crude fibre and poorer in crude protein.

The alfalfa cured in the sun has a larger pure protein content, as deter mined by STUTZER'S method, than that cured in the shade. This differenc is so great as to more than offset the influence of the loss of leaves, and i was also most pronounced in the alfalfa cut in the earlier stages.

The adjoined Table sums up the principal results of the experiments

To sum up, the feeding value of hay is affected not only by mechanica losses due to handling, and the changes due to bacterial action, but als by chemical changes which have hitherto been little noticed or understood.

1077 – **Studies of the Timothy Plant.** – WAYERS, H. J. in *University of Missouri, Colleg of Agriculture, Agricultural Experiment Station, Research Bulletin*, 19, pp. 1-68, 3[illegible] + 19 tables. Columbia, Missouri, June 1915.

Experiments have been conducted to determine the influence of t stage of maturity of timothy upon the yield, composition, digestibility a the nutritive value of the hay and also upon its palatability to animals. T investigations were begun in 1896 and continued with more or less int ruption till 1909. The cutting of the timothy was done at different stag of maturity; 1) about June 12th, when the plants were just in full hea 2) about June 20th, when the plants were in full bloom; 3) about July 1 when the seed had formed; 4) about July 8th, when the seed was in doug 5) about July 16th, when the seed was ripe but not fallen. Harvesting a analysis were carried out in the usual way. In the first digestion trial tw year old high grade Shorthorn steers were used, and in the others, yearli grade Shorthorn steers. Tests of palatability were made with yearli beef steers fed on hay alone; with Jersey cows in milk, fed with silag corn, stover and mixed grain, in addition to the hay under test; and wi yearling sheep fed only with mixed grain and the hay under test.

The following results were obtained:

The yield of cured hay. In two years, the yields of hay were greate from the fourth cutting, when the seed was in the dough stage; in tw years, the yields were greatest from the third cutting when the seeds we beginning to form; and in one year, from the fifth cutting, when th plants were fully ripe. The average result of all the trials shows th largest yield from the third cutting, when seeds were beginning to form

If the yield from the third cutting were expressed as 100, the yiel from the other cuttings would be 99.3 for the fourth cutting, 93.6 for t second, 89.7 for the fifth and 89.4 for the first. Thus, the differen

between the third and fourth cuttings was slight, averaging but 43 lbs of hay per acre. The difference between the yield of the first and last cuttings was small, but these cuttings produced an average of between 500 and 600 pounds less hay to the acre than did the third and fourth cuttings. Thus these intermediate periods, when the seeds have been formed, show the maximum yields of cured hay.

The yield of digestible nutrients. The yield of digestible nutrients is a much more accurate measure of the value of the harvest than the quantity of cured hay obtained. When measured by the standard of digestible nutrients produced, the earlier cuttings make a more favourable showing than when measured by the amount of cured hay produced. This is because the animals digest the early-cut hay more completely than they do the late-cut hay. The digestibility of timothy hay declines steadily as the plant develops, beginning as early as when the plants are in full head. The second cutting, when the plants were in full bloom, gave the largest yield of digestible dry matter, digestible protein, digestible fat, digestible crude fibre and digestible nitrogen-free extract of any of the five cuttings. In Table I are summed up the coefficients of digestibility of the different cuttings, given as the mean of all the trials.

TABLE I. — *Summary of average digestion coefficients of all trials.*

Cutting	Digestion coefficient					
	Total dry matter	Protein	Ether extract	Crude fibre	Ash	Nitrogen-free extract
	per cent	per cent	per cent	per cent	per cent	per cent
First	58.51	51.61	38.12	65.78	34.76	55.02
Second	54.88	50.09	35.62	58.73	32.01	55.42
Third	49.86	41.63	45.87	51.49	29.32	52.45
Fourth	47.39	38.78	48.85	48.98	31.76	48.97
Fifth	47.37	42.05	43.06	50.87	28.45	47.56

Table II sums up, for each of the five cuttings and as a mean of all the experiments, the absolute and relative yield of digestible substances; in this case the relative figures are expressed in terms of the greatest amount of each substance, reckoning this maximum as 100.

Palatability of hay as affected by the time of harvest. — Yearling steers fed entirely on timothy hay, when given free access to the hays from all the cuttings, in every case showed preference for them in the order in which they were cut. The fourth and fifth cuttings were left almost untouched until the hays of all earlier cuttings had been entirely eaten. Milking cows, having grain and other roughage besides the hays under test, were not so discriminating in their taste as regards the first three cuttings, but they, like the steers, left the fourth and fifth cuttings almost untouched until

TABLE II. — *Average yields of digestible nutrients per acre.*

Cutting	Dry Matter		Crude protein		Ether extract		Crude fibre		Ash		Nitrogen-free extract	
	Actual	Relative	Actual	Relative	Actual	Relative	Actual	Relative	Actual	Relative	Actual	Relative
	lbs	%	lbs	%	lbs	%	lbs	%	lbs	%	lbs	%
1	1 995.7	91.7	134.7	91.9	42.8	79.1	777.0	98.9	77.1	93.4	899.3	83.1
2	2 175.3	100.0	146.5	100.0	43.8	80.9	785.7	100.0	82.5	100.0	1 082.1	100.0
3	2 038.8	93.7	113.3	77.3	50.9	94.1	761.7	96.9	69.8	84.6	1 040.6	96.1
4	1 913.7	87.9	98.0	66.9	54.1	100.0	699.9	89.1	67.4	81.7	995 5	92.0
5	1 774.8	81.6	91.9	62.7	37.5	69.4	683.1	86.9	63.0	76.3	892.6	82.5

the first, second and third cuttings were eaten. Sheep, full fed on mixed grain, appeared to eat one cutting with as much relish as another.

The permanence of the stand. — The results show conclusively that the time of cutting affects the length of life of a meadow. Early cutting tends to weaken the stand and late cutting to conserve the strength of the plant and prolong its life.

1078 – **The Artichoke as a Forage Plant.** — VASQUEZ A. in *Revista de la Cámara Agrícola Balear*, 18th year, No. 15, pp. 113-119. Palma de Mallorca, Aug. 10th 1916.

A good summer forage plant for dry countries must be deep rooted, and must use little water during the summer. Both these conditions are fulfilled by the cardoon (*Cynara Cardunculus*) and the artichoke (*Cynara Cardunculus* var. *Scolymus*). Given a favourable season, if these plants are sown in autumn their roots will reach a depth of 3 feet in less than 10 months and 4 feet in 20 months. Besides this, if the plant is cut in spring it develops few or no leaves during the summer, so that the amount of water lost by transpiration is much reduced ; the roots, however, continue to grow and strike down into deeper strata of the subsoil, and when the great heat is over they supply the plant with the subsoil, thus enabling new shoots to be formed.

The value of these forage plants has been proved by experiments carried on for several years in the province of Toledo, in Spain, by *Celedonio Rodrigañez*.

Various species of artichokes have been tested and the best results have been obtained with variety well known in Andalusia and the neighbouring provinces under the name of " arcaucil " or " alcaucil ", and on the market as " alcachofa verda de Provenza ". Among the cardoons the " cardo de España " was the most successful. Naturally species with many spines are to be avoided.

The cardoon is propagated by seed, the artichoke by cuttings, but if the latter cannot be watered they root with great difficulty. In this case seeds must be sown and the seedlings pricked out in 6 or 8 weeks into well worked soil ; the rows should be 32 inches apart, and the plants 32

inches apart in the rows, arranged on the square. Autumn is the best time for sowing, but it can also be done in the spring. The quantity of seed needed is 1 3/4 to 2 3/4 lbs per acre, and it should be soaked in water for 24 hours before sowing.

The necessary cultivation consists of four weedings per annum: in spring, May or June, August and winter.

One or two cuttings are made in spring and one in autumn, the first being made when the plants reach the age of 18 months. The first spring cutting may produce as much as 48 tons of green forage per acre. The second spring crop yields up to 8 tons per acre, and the autumn crop to 30 tons per acre.

To obtain the maximum of forage the crop should be mown just when it begins to come into flower, but as this procedure weakens the plant it is better to cut a little earlier, level with the ground, care being taken not to injure the collar of the plant. One labourer will cut and tie about one acre in a day.

The artichoke is not suitable for ensilage, but it makes good hay. The forage is readily eaten by cows and bullocks, horses, mules, pigs and goats. Milking cows fed exclusively with this forage do not show any change in their conditions nor in the milk that they produce.

The introduction of this forage plant into Majorca is recommended.

079 – **Analysis of Cotton at the Chief Stages of its Development** (Publications of the Experiment Station of the "Golodnaia Steppe", Samarkand district). — ROGALSKIJ B. V. in *Журналъ Опытной Агрономіи* (Review of Agricultural Experiments), Vol. XVII., Book I, pp. 13-36. Petrograd 1916. FIBRE CROPS

In order to obtain preliminary data for a more exhaustive study, experiments have been carried out on the variety "King" which belongs to the Upland group (*Gossypium hirsutum* L.) and which seems to be well suited to the region of the Golodnaia Steppe (1) a part of the Russian possessions in Central Asia. The year 1913 was meteorologically favourable to cotton, and no damage was done by the harmful salts, especially chlorides and sulphates, which are present in remarkable quantities in the soil of this region. The cotton was cultivated on irrigated soil, which was clayey in texture, and not too impregnated with salts.

(1) The "Golodnaia Steppe" is a vast, slightly undulating plain, with a hardy perceptible slope; it is traversed by the railway and, according to approximate calculations, it possesses about 200 000 acres perfectly suitable for irrigation and the cultivation of cotton. See "Culture of Cotton in Russia" by KNIZE A. I., in «Ежегодникъ Главнаго Управленія Землеустройства и Земледѣлія по Департаменту Земледѣлія и Лѣсному Департаменту за 1907 годъ» (Annual Report of the Department of Agriculture and Forestry) S. Petersbourg, 1908, pp. 315-361. A description of the climatic conditions, soil and vegetation of the Golodnaia Steppe is given in the Compte Rendu of the Experimental Farm of the same name, for 1906, published by the Director, BUCHAEV, M. M., in «Труды Хлопковаго Комитета, томъ I». (Publications of the Cotton Committee), edited by the Department of Agriculture, St. Petersbourg, 1907, pp. 71-150. (*Ed.*)

The vegetative period of the plant extended over 174 days, the seeds being sown on May 7th. Analyses were made at four different times:

1) When the flower buds first appeared (June 7th).

2) At the beginning of flowering (September 22nd).

3) At the first picking (September 29th).

4) After the death of the plants, which was caused by the morning frosts (October 28th).

The first two analyses were made on the whole plant; in the last two the following parts were analysed separately: hairs (lint), seed minus its coats, seed coat, unripe capsules, fruit coats, stems and leaves.

The maximum growth of the plants is reached at the time of the first picking the average weight of a single plant being 196.67 gm. when green, and 82.10 when absolutely dry. When the plant dies the weight decreases on account of dessication and the loss of parts of the plant, the average green weight then being 116.93 and the dry weight 54.69.

The percentage of water in the green weight gives an unexpected result in comparison with other plants; this percentage is greater at the beginning of flowering than when the flower buds appeared (80.89 against 73.81); in the two later periods it was 58.25 and 52.23 respectively. A possible explanation of this lies in the fact that in the early stages of development cotton is sensitive to the harmful action of the salts in the soil. Yet another explanation may be that during the flowering period the plant needs much water to promote an active circulation of food materials.

The appended table sums up the analytical results. This table, together with others, which are given in the text of the paper, show that the chief modifications occurring in the cotton plant during the various stages of its development are as follows:

1) As time goes on, there is of reduction in the relative amounts of nitrogen, nitrogen-free extracts and ash; the maximum amounts of ash and N - free extract occur in the green parts of the plant.

2) The percentage composition of the ash shows that cotton demands potash more than anything else, then lime, and finally phosphorus. The ash also contains large amounts of chlorides and sulphates, the substances which work the greatest harm to the agriculture of the district. The plant fights against this harmful action by developing its vegetative organs rapidly.

3) As the plant develops there is an accumulation of raw cellulose and pentosans, which form the cell walls.

4) The analysis of the cotton itself, by the methods adopted by KONIG, GROSS and BEVAN justifies the hypothesis that it is not pure cellulose, but a mixture of cellulose and hemi-cellulose. For cotton of the first quality, the composition is 71.190 per cent cellulose (α cellulose) and 21.35 per cent (β cellulose).

5) The green parts of the plant and the seeds contain a high percentage of fats, and the greater part of the percentage in the whole plant occurs in these parts.

Taking the ash analysis as a basis, and reckoning 21 680 plants to the

... Golden Barley King, grown in 1913 on the « Golodnaia Steppe ».

No. of sample	Description of sample	In 100 parts of the green substance of the plant	In 100 parts of the dry matter of the plant	Percentage composition of dry matter: Nitrogenous compounds	Raw cellulose	N-free extract	Starch	Pentosans	Raw fats	Ash	Total of estimated substances	Total of unestimated substances
				per cent	per cent	per cent	per cent	per cent	per cent	per cent	per cent	per cent
36	*At time of appearance of flower buds* . .	—	—	19.224	12.908	23.236	0.599	9.454	4.652	23.656	93.729	6.271
91	*At beginning of flowering*											
	Plants with flowers	—	—	17.466	21.543	18.019	0.816	9.289	2.664	12.494	82.291	17.709
	Plants without flowers	—	—	17.225	22.089	19.193	0.567	9.020	2.578	12.441	83.113	16.887
	First picking											
208	Lint	3.291	6.909	1.683	91.484	1.191	0.084	1.644	1.523	2.352	99.961	0.039
208	Seed without coat	6.915	8.213	23.762	4.325	8.582	0.482	3.884	48.988	3.454	93.477	6.523
208	Seed coat		6.438	3.141	53.025	1.587	0.352	20.114	3.000	2.556	83.775	16.225
208	Unripe capsules	47.338	38.558	10.362	39.740	6.302	0.360	11.302	14.001	3.982	86.049	13.951
208	Fruit coat	4.249	9.135	3.231	28.770	14.901	0.449	16.100	1.139	4.783	69.373	30.627
208	Stems	27.002	20.370	4.171	41.952	9.722	0.673	19.256	1.239	4.818	81.831	18.169
208	Leaves	10.605	10.371	7.949	13.446	36.197	0.745	7.018	7.926	19.012	92.293	7.707
	Whole plant . . .	100.000	100.000	8.235	37.980	10.414	0.462	12.209	10.898	5.534	85.738	14.263
	At time of death of plant											
240	Lint	2.919	5.263	1.357	92.127	1.023	0.103	1.465	0.692	1.839	98.606	1.394
241	Seed without coat	7.430	8.432	26.443	2.691	11.561	0.444	4.926	44.739	5.724	96.528	3.472
241	Seed coat		5.852	3.842	51.526	1.642	0.224	20.009	1.423	2.539	81.205	18.795
243	Unripe capsules	20.915	14.589	10.035	39.815	6.409	0.375	11.257	13.937	3.972	85.800	14.200
243	Fruit coat	11.991	17.554	2.099	41.733	11.243	0.559	17.595	2.179	4.484	79.896	20.014
244	Stems	48.596	38.957	3.115	36.467	7.802	0.453	18.885	0.875	3.104	70.701	29.299
242	Leaves	8.143	11.353	8.820	18.421	27.240	1.039	5.749	6.618	20.936	88.823	11.177
	Whole plant . . .	100.000	100.000	6.045	37.470	9.934	0.494	14.304	6.508	5.507	80.322	19.698

acre, it is calculated that in order to avoid the exhaustion of the reserves of phosphoric acid, potash and nitrogen in the soil, the following manure must be applied to each acre of cotton grown: 1 cwt. superphosphate (20 per cent), 2 cwt. potash salts (30 per cent) and 3 cwt. nitrate of soda, containing 15.5 per cent of nitrogen. If nitrification and the fertilizing matters contained in the irrigation water are taken into account, rather less of the above substances will be needed. Calculations for chalk and magnesia have not been made, as they are so abundant in the soil of the district.

1080 – **Osier Culture in France.** — I. MIR, E. Osier Culture in France in *Vie agricole et rurale*, 6th year, No. 32, devoted entirely to osier culture, Paris, August 5th, 1916, pp. 89-90. — II. CAMUS, E. G. The various Osiers cultivated in France and in neighbouring countries. *Ibidem*, pp. 95-98, 7 fig. — III. DE LA BARRE, G. The national school of osierculture and basketwork. *Ibidem*, pp. 105-106, 1 fig. — IV. DR. BONNARDOT. Co-operative osier selling. *Ibidem*, pp. 106-107.

I. Forty years ago, France devoted about 175 000 acres to osier culture, and, at this time, she supplied most of the European markets with osiers, especially in Germany, England, Spain and Switzerland. The cultivation of osiers has declined, little by little, until now only about 20 000 to 22 500 acres are grown. Osier culture has suffered because:

a) Its progress was hindered at one time by the inability of the growers to organise the sale.

b) In many districts the osierbeds were cultivated by hand and, in the absence of sufficient labour, were allowed to become foul.

c) Pure varieties were rarely planted, and the vigorous varieties choked out the more delicate ones so that the osier beds were shortlived.

d) Attempts were made to establish osier beds on unsuitable soil.

II. This article gives a systematic classification of the various osiers cultivated in France, with their scientific and common names. Basket work needs especially the varieties which yield long slender twigs, elastic to bending and to twisting.

The colour and hairiness or roughness of the plants is not important from the botanical point of view, as these conditions depend upon the environment of the individuals, but they must be taken into account in the practical cultivation of the osiers. These characters are maintained by the practice of taking cuttings for planting out osier-beds.

Commercially, much confusion exists between the names used for the cultivated varieties. The same name is often applied, according to the district, to several species or varieties, and the same variety is often known under several different names. The Chamber of French Osier Growers has appointed a Commission of Nomenclature to remedy this state of things. The chief species and varieties of osiers cultivated in France are the following:

(1) *Willows with the scales of the floral catkins selfcoloured, falling off before the ripening of the fruits.* — *Salix alba* L. (white willow, silver willow). Names recommended by the Commission of Nomenclature.: Osier blanc suisse, ardennais. Other names: Vuisier, Saouzé, Saudre, Bray. In cultivation, one-year old twigs are often 6 ½ feet long, varying in colour

often being pale grey, dashed with green, or yellowish, or even olive-green. Very widely cultivated.

S. Alba L. var. *Vitellina*, Ser., *S. Vitellina* L. Names recommended: *S. Vitellina*, var. rouge, var. jaune, Amarinier, Osier de tonellerie. Other names: Osier de Metz, osier rouge (a name leading to confusion) osier jaune, Bouton blanc, Grand roux, Saule doré. The branches are longer and more slender and flexible than in the preceding case, with, at the end of the summer, a colour varying from citron yellow to orange yellow or sometimes to coral red. These two species above described yield a much valued type of osier.

S. fragilis L. Names recommended:. Saule fragile or Osier fragile, var. pourprée, Osier franc. Other name: Osier rouge (leading to confusion). This osier is weak at the joints, but still it is much used in semifine basketwork.

With these species may be compared *S. pentandra* L. and *S. babylonica* L.

(2) *Catkins appearing before the leaves; scales persistent, discoloured*: *Salix viminalis* L. Names recommended: Osier viminal, O. jaune, O. vert, O. des vanniers, queue de renard, merrin brun. Other names: osse, pêcher jaune, O. noir de Hollande, O. de longues feuilles.

The shoots reach a length of 10 to 13 feet. This excellent species comprises a rather large number of varieties, of which one is known abroad as the "French Osier".

S. purpurea L., *S. monandra* Hoff. Names recommended: O. à une étamine, Sardine, Verdiau. This is known in England as *Dick* with varieties, Dick with red buds, black Dick, old Dick and Dick of the fields. Not very much cultivated.

Near this willow comes *S. rubra* Huds, or the red willow of botanists, which is specially recommended for introduction into cultivation.

(3) *Catkins appearing at the same time as the leaves, scales self-coloured, persistent*: *S. triandra* L. This includes two botanical varieties: *S. amygdalina* L. for which the names osier brun or vache brune are recommended and *S. triandra* L. Brunette, Grisette, Saule à feuilles d'amandier or à trois étamines.

Other varieties suggested for use in basket work are: — *S. cinerea* L.; *daphonides*, *S. Caprea* L., *S. aurita* L., *S. nigricans* Sm., and *S. repens* L., var. *argentea* Koch.

III. The National School of Osier Culture and Basketwork, founded by decision on Jan. 3rd, 1905, is situated at Fayl-Billot (Haute Marne). The length of training is three years, with a faculty course for adults. A diploma is awarded at the close of the school course to the students who have satisfied the examiners. The school has organised experimental fields where 80 varieties are cultivated. A rational nomenclature is sought. Various cultural methods are investigated dealing with manuring, distance of planting, depth of soil, length and thickness of cuttings, methods of checking parasites, grafting especially on poplar, etc.); and laboratory experiments have also been carried out on the coefficients of torsion and

bending of osiers etc. In addition a course of basketwork has been founded and three workrooms have been established for various kinds of basket making.

IV. For thirty years osier cultivation has been carried on in the department Cote d'Or on soil which is not very damp and which is most unfertile. The plantations occupy about 1500 acres. In 1913 the harvest was exceptional in quantity and quality; this caused a considerable drop in the price offered by buyers, which fell from £1 per cwt. to 9s 0*d*. or 9s 5*d* per cwt. To remedy this state of affairs, the producers decided to sell their osiers themselves and to this end they formed the Co-operative Society of Aisrey. This society founded in August 1913, has 140 members, from 15 villages. The results have been as satisfactory as was hoped, and the drop in price was stopped by the formation of the Society.

1081 – **Nitrogen Requirements of the Olive-tree.** — See No. 1068 of this *Bulletin*.

1082 – **The Dyeing Value of Some Indian Dye-Stuffs.** — SRIVASTAVA, I. P. (Technological Chemist, Cawnpore) in *The Agricultural Journal of India*, Special Indian Science Congress Number, pp. 53-64. Calcutta and London, 1916.

The following investigation into the dyeing values of certain natural colouring matters still used by native dyers was undertaken under the orders of the Director of Industries, United Provinces.

The colouring matters were tried on wool and cotton by some of the more important methods of modern dyeing. The inquiry has so far been prosecuted in regard to the following colouring matters :

(1) HARSINGHAR (*Nyctanthes Arbor-tristis*). — The flowers of this tree, which occurs in abundance in the United Provinces, contain a beautiful yellow colouring matter soluble in water, also in alcohol.

Harsinghar gives brilliant yellow shades with all mordants on wool. On wool mordanted with bichrome and oxalic acid previous to dyeing a beautiful brown is obtained. The dyeings on wool possess good fastness to milling with soap and soda.

(2) TUN (*Cedrela Toona*). — This tree is said to occur largely in the sub-Himalayan forests. The colouring matter is contained in the flowers which are dried and sold. The principal constituent of the flowers is a yellow dye.

Tun dyes the best shade on wool which has been previously mordanted with aluminium sulphate and tartar. The dyeings on wool are, however, not very fast to milling with soap and soda.

(3) TESU or DHAK (*Butea frondosa*). — This tree is found in abundance all over the United Provinces. The flowers contain a yellow colouring matter.

Tesu dyes on wool shades varying from brown to dull crimson according to the mordant used. The dyeings are fairly fast to milling.

(4) HALDI or TURMERIC (*Curcuma longa*). — The plant which yields *haldi* is grown all over the United Provinces. *Haldi* is a dried rhizome or tuber and is a well-known constituent of curry powder. It contains

brilliant yellow colouring matter which however possesses the serious drawback of being changed into red by soap or by alkalis.

The colouring principle is called *curcumin*; it is sparingly soluble in cold water, more freely in hot water, and completely in alcohol.

The best shade is obtained on wool previously mordanted with bichrome nd oxalic acid. The fastness of the dyeings on wool is fair.

(5) ARUSA (*Adhatoda vasica*). — The leaves of this plant yield a yelw colour. *Arusa* is an ever-green plant and is found in the United Proinces. The colouring matter is soluble in water and also in alcohol. On ool the best shade is obtained on the same mordant as above. The fastess of the dyeings on wool is fair.

(6) NASPAL, or POMEGRANATE RIND (*Punica granatum*). — The ind of the fruit contains a tanning substance and also a yellow colouring natter.

Pomegranate rind dyes very good shades varying from yellow to full rown on wool. All these possess very good fastness to milling.

(7) JANGLI NILL or WILD INDIGO (*Tephrosia purpurea*). — This is small woody annual occurring in abundance in the United Provinces.

Clarke and Bauerjee have discovered in the leaves of this plant a couring principle allied to quercetin or quercitrin (vide *Trans. Chem. Soc.* 1910, V, 97). Owing to the difficulty of separating the yellow principle from the chlorophyll, efforts to obtain a pure yellow from *Tephrosia* have only been partly successful. The colouring matter is, however, of great value, as it yields dyeings which are compratively fast to light, washing and milling. On account of the abundance of the plant it may be worth while devising a suitable process for extracting the yellow colouring principle. A decoction of the leaves of *Tephrosia* dyes wool mostly dull brown shades in conjunction with the various mordants, the most brilliant shade being that on tin mordant. The dyeings, however, possess very good fastness to milling.

(8) SAFFLOWER or KUSUM (*Carthamus tinctorius*). — The dried wers of safflower plant contain a colouring matter which before the introducn of coal-tar colours was higly prized all over the world. It produces cotton beautiful shades of red varying from a full crimson to the most licate pink.

Although the yellow colouring matter in safflower is generally regarded useless, Hubner has shown that certain mummy cloths which he examinhad been dyed with safflower yellow. The Egyptians were therefore quainted with the right way of using safflower yellow.

Safflower yellow does not dye cotton in conjunction with aluminium nd tin mordants. Wool, however, possesses affinity for the yellow colour nd may be dyed direct.

(9) MAJITH (*Rubia cordifolia*). — The root and twigs, of this plant ontain a dye-stuff identical with madder. *Majith* was largely used in Inia before the advent of synthetic alizarine. It is undoubtedly one of the ost valuable indigenous dye-stuffs., Wilth its help red, maroon, and borleaux shades of excellent fastness to light can be dyed on all fibres. It is he basis of a great many colours required by the calico-printers. *Majith*,

as might be expected, dyes very fast shades on both wool and cotton. The best results on cotton are obtained by using the Turkey Red process.

(10). CUTCH or KATHA (*Acacia catechu*). — The catechu tree is found in several parts of India. Catechu may be applied to all fibres, though it is most largely used for dyeing cotton. Catechu brown is one of the fastest colours known.

(11) PATANG or SAPPAN WOOD. (*Coesalpinia sappan*). — This tree is said to grow abundantly in Cuttack and in Central India. The colouring principle *brazilein* exists in a colourless condition in the freshly cut wood and is by oxidation converted into the true colouring matter *brazilein*. *Patang* is a valuable colour-yielding material. It can be used for producing brilliant shades of red, crimson, and purple and is very suitable for calico-printing.

(12) LAC DYE. — This substance is of animal origin.

Lac dye is manufactured largely in the North Western Provinces, though like other natural products it has lost much of its former importance. Lac dye is dyed on wool; chiefly on tin mordant. It yields beautiful scarlet and crimson shades.

(13) INDIGO. — The use and importance of Indigo are too well known to need any comment.

(14) KACHNAR (*Bauhinia racemosa*). — This is a shrub very common in the North Western Provinces. The bark yields a red dye which is largely associated with tannin. The dye is not very bright but nevertheless it may be employed for dyeing dull reds on cotton. It may be dyed on cotton without the help of any mordant. The bark can be had in any quantity and may be of service to tent manufacturers who require a dull red colour for the inside of tents.

(15) PEEPUL (*Ficus religiosa*). — The roots of this well-known plant were examined and found to contain a red dye which gives a good pink on cotton mordanted with alumina. The shade so obtained is fairly fast.

(16) RED SANDERSWOOD (*Pterocarpus santalinus*). — This is a small tree occuring in Southern India. The wood yields a valuable red dye called santalin.

Sandeiswood dyes wool without any mordant. Very good shades of satisfactory fastness are obtained on cotton, on tin and alumina mordants. The dye does not dissolve in water though it is freely soluble in alcohol and acetic acid.

(17) ROLI or KAMELA POWDER (*Mallotus philippinensis*). This dye is obtained from a small tree found along the foot of the Himalayas and in Southern India. The fruits have red glands on the surface of the capsule and the powder is obtained by crushing or breaking up these glands. Kamela gives a beautiful yellow on silk mordanted with alumina. The dyeing must be done in an alkaline bath.

(18) AKHROT (*Juglans regia*). — The bark yields a valuable brown dye.

(19) KATHAL (*Artocarpus integrifolia*). — The wood yields a yellow

dye which may be dyed on cotton on alumina mordant. The shades obtained are good and fast.

(20) BARBERRY (*Raswat*). — The bark, roots, and stem of this plant are rich in a very good yellow dye. This plant is plentiful in the Kumaun Hills.

Raswat is used chiefly as a dye for silk. It was dyed on cotton mordanted with alumina, but dull shades were obtained. This was perhaps due to the presence of chlorophyll in the preparation which came from Naini Tal.

(21) *Rhus cotinus*. — The wood of this plant yields a dye similar to young Fustic. On cotton mordanted with alumina an orange yellow colour was obtained; with tin an orange red was obtained. The dyeings are, however, not fast to alkalis and soap.

083 - **The Harvesting and Cultivation of Medicinal Plants in France.** — *Feuille d'Information du Ministère de l'Agriculture*, 21st year, No. 28, pp. 12-13. Paris, July 14th, 1916.

STIMULANT, AROMATIC, NARCOTIC AND MEDICINAL PLANTS

The question of the production of medicinal plants in France, as in other countries (1) is one of great importance. The history of the cultivation and harvesting of medicinal plants is given in this paper and the fact is recalled that the list of simple indigenous drugs inscribed in the Codex of 1908 comprised not less than 110 species. Although most of the indigenous medicinal plants grow naturally over large areas, yet several among them grow best and most abundantly in certain districts where the temperature and soil are specially favourable to their development and to the elaboration of their active principles; so much so that the same species, cultivated in neighbouring districts differing in soil and exposure, will in the one case acquire a very great toxicity, while in the other its properties are much less active. Digitalis is a striking example of this type of medicinal plant; that grown in the Vosges is very rich in digitalin, while that from the Ardennes contains but very little. This instance shows that the cultivation of certain plants demands special precautions, definite knowledge and scientific control. To entrust the work to inexperienced hands would be to vitiate the results.

The article outlines the principles which should govern the cultivation and harvesting of the plants and gives, besides indications of the price and the extent of sale of each, the following list of the chief medicinal plants grown in France, classified according to the part which is of use:

Flowers: Arnica, blue-bottle (with calyx), mullein, borage, colchicum, poppy, marshmallow, lavender, mallow, milfoil (clusters), lily-of-the-valley, white dead-nettle (without calyx), ground ivy, chamomile, elder, lime (bracts), coltsfoot, Auvergne violets, pasque flower, meadow sweet (clusters), hawthorn, bugloss, marjoram, broom.

Leaves: Wormwood, agrimony, silverweed, woodruff, cranesbill, borage, shepherd's purse, yellow cheese-rennet (clusters), catmint, blackcurrant, eyebright, ash, goat's rue, yellow melilot (cut tips), mercury, St. John's wort, lily-of-the-valley, walnut, poppy, plantain, meadowsweet, bramble, soapwort, henbane, ground ivy, balm-mint, thorn apple, night-shade, hart's tongue, wild thyme, figwort, tansy, valerian, veronica, vervein.

(1) See *B.* July 1916, N. 757. (*Ed.*).

Roots: Restharrow, elcampane, bistort, bryony, carex, couchgrass, comfrey, chicory, dock, dandelion, polypody, soapwort, Solomon's seal, tormentil, valerian.

Bulbs: Colchicum.

Fruits: Whortleberry, caraway.

Buds: Poplar, pine.

Various: Cherry stalks, Horse Chestnut.

Marine plants: Corsican Moss, laminaria.

Some plants because of the high prices that they command on account of the variety of ways in which they are used and their world-wide consumption, are cultivated on a large scale. The most notable among these are: belladonna, (of which the price has risen from about 7 ½ *d* to 8s 6*d* per lb), marsh mallow, mallow, mullein, henbane, borage, chamomile, peppermint, valerian, aconite, balm, hyssop, sage, male-fern, black currant, horse-radish, scurvy grass, parsley, coriander, angelica, small centaury, gentian, sweet marjoram. Attention is also drawn to the cultivation of saffron and mustard.

HORTICULTURE

1084 – **Summer Treatment of Greenhouse Soil.** — GREEN, W. J. and GREEN, S. N. in *Ohio Agricultural Experiment Station, Bulletin* No. 281, pp. 53-68, 5 fig. + 2 diagrams Wooster, Ohio, 1915.

For an interval of six to ten weeks during midsummer, vegetable greenhouses usually stand idle, because vegetables grown in the open air are abundant and cheaper. The greenhouse grower does not consider it necessary to renew the soil annually, an operation which is decidedly costly. The general opinion is that the intense heat under glass during July and August, together with the dryness of the soil, will destroy all insect life as well as fungi and bacteria. This view is open to serious doubt. In order to determine the practical difference between the various methods of treating the soil during the summer months when cultivation is stopped, experiments have been carried out at the Ohio Station greenhouses. The following methods of treatment have been compared:

New Soil Plot. Each year, just before the crop was to be planted in the autumn, the entire soil of this plot was removed and replaced with fresh soil. This soil was the ordinary "Sod compost" prepared according to the usual Ohio methods. The spring crop of tomatoes received a light mulch of manure.

Straw Mulch Plot. This and the succeeding plots were of soil that had been cropped for at least three seasons. Immediately after the crop was removed each spring this plot was given a covering of from four to six inches of wheat straw. Both the straw mulch and the manure mulch plots were kept well watered during the summer, though excessive wetness was avoided. Most of the straw was removed before preparing this bed for the autumn crops, as it decayed but little and could not be worked into the soil. A covering of straw was given to the spring crop of tomatoes, just as the fruit began to ripen.

Manure mulch plot. This plot was treated in the same way as the preceding one, except that the straw was replaced by a mulch of very fresh manure. The latter was sufficiently decomposed by autumn to

be worked into the soil before planting. A mulch of manure was also given to the spring crop of tomatoes.

Dry-Plot. During the time between seasons in the summer this plot remained bare and unwatered. Before the autumn crops were planted it received fresh manure which was worked into the soil. The spring crop of tomatoes also received a mulch of manure.

On the plots thus treated two crops of tomatoes were grown each year, one in autumn and one in spring. The figures given in Table I sum up the results obtained from 1908 to 1914.

TABLE I. — *Tomato Crop; Average Weight per Plant.*

lots	Autumn Crop (1908-1913)	Spring Crop (1909-1914)
	lbs.	lbs.
ew soil	4.1	8.4
raw mulch	3.4	6.3
anure mulch	3.7	7.4
ry plot	2.1	6.8

addition lettuces were grown from 1911 to 1913, and Table II gives e results obtained during this period, as a general average of spring and tumn crops.

TABLE II. — *Lettuce Crop; Average Weight per Plant.*

Plot	Spring and Autumn Crops 1911-1913
	oz.
l cultivated and manured for 10 years	4.40
w soil	3.55
aw mulch	2.98
nure mulch	4.18
plot	4.11

om the results of these experiments and from others carried out with cumbers, the following conclusions are drawn:

1. The common greenhouse crops of Ohio, tomato, cucumber and ttuce, require different soil conditions for maximum yields.

2. Lettuce can be grown continuously with safety on unrenewed l with application of manure.

3. Tomatoes and cucumbers are sensitive to conditions found in

old soil and the yields are quickly affected, necessitating treatment or renewal of soils after two or three seasons' use.

4. The drying of the soil during the idle summer period seems to adversely affect the soil conditions for tomatoes, but not for lettuce.

5. Summer manure mulch is recommended to check adverse soil conditions for tomatoes and cucumbers.

6. Summer mulch may not obviate the necessity for soil sterilisation, but, in part, it appears to answer that purpose.

FRUIT GROWING

1085 – **California Grapefruit.** — SHAMEL, A. D. in *California State Commissioner of Horticulture Monthly Bulletin*, Vol. IV., No. 7, pp. 239-249. Sacramento, Cal., July 1916.

The early plantings of grapefruit in California were made with Florida varieties which were selected without much knowledge of their adaptability to California conditions.

It is only in recent years that any data has been gathered as to the comparative value of several varieties with regard to their adaptability. Among these varieties the Marsh Seedless takes the first place.

It has also become evident from these studies that the grapefruit planted on rather light, porous and sandy soils produce fruit of a superior commercial quantity, colour and texture of rind to those planted on the heavier clay soils. While most of the older plantations were made in the lower valleys, most of the more recent plantings have been made on higher lands having lighter soil of more suitable texture. The other Florida varieties most largely grown in California are the Triumph and Duncan.

The orchards of Triumph grapefruit in Southern California are very productive, but the fruit is rather small and contains numerous seeds, from 25 to 50 ; this seriously hinders its spread in the commercial orchards.

The Duncan grapefruit trees tend to produce large round fruits, but these also contain too may seeds for market purposes. The other varieties cultivated to a certain extent are the Imperial, Colton Terrace Seedling Aurantium, Commercial and the Blood. The results so far obtained with those varieties can hardly be considered successful, so that the variety Marsh or Marsh Seedless will gradually replace all the others.

According to Vaile 600 acres of grapefruit trees are in bearing in California, capable of yielding 250 carloads of fruit per annum. 1 100 additional acres of trees under five years of age will soon double the present output.

According to the same writer, Florida has 16 000 acres of grapefruit trees in full bearing, yielding 8 000 carloads of fruit, and in addition about 45 000 acres of trees under five years of age which will eventually yield at least 35 000 carloads of fruit.

Porto Rico, in 1913, exported to the United States 500 carloads of fruit and Cuba, in 1912, 250 carloads. The export from Jamaica is also rapidly increasing. Although the cultivation of grapefruit in California is established on a sound basis, Vaile thinks that much prudence should be exercised in the future extension of the orchards. Two facts must be borne in mind in this connection. First of all, the importation of grapefruit into California has been stopped in order to prevent the introduction of insect pests and fungous diseases by this means, and probably other States where the

grapefruit is cultivated will take similar steps. This will force California to provide for its own consumption by its own production. Secondly, the period of ripening of California Marsh Seedless grapefruit is during the summer months when no other district has a ripe crop available to supply the Eastern markets. The success of the grapefruit industry in California will largely depend upon a careful study, by the growers, of the condition of fruit ripening and on the adoption of a commercial standard of ripeness. In this connection the analyses made by the Laboratory for Agricultural Chemistry at Los Angeles on various samples of grapefruit from California and Florida are of special interest. The average composition of the « standard » grapefruit of the variety Marsh Seedless, grown on one of the best southern plantations, is as follows :

Average weight per fruit	20 1/4 oz. (574 gm)
Rind	28.72 per cent
Pulp	71.03 per cent
Juice	69.63 per cent
Number of seeds, per fruit	10.6
Total solids in pulp	12.92 per cent
Soluble solids in juice	11.52 per cent
Total sugar in juice	7.50 per cent
Acid in juice	1.28 per cent
Solids acid ratio	9.0

It may be taken as proved that the "standard " type of the Marsh Seedless variety can be isolated in propagation by bud selection based on the records of the performance of individual trees. This method of selection is put forward at the California Fruit Growers' Convention at Visalia, and if intelligently applied it will probably result in a great improvement in the type, both as regards quantity and quality of production.

LIVE STOCK AND BREEDING.

86 - **The Effects of Snake Venom on Domestic Animals and the Preparation of Antivenomous Serum.** — MITCHELL D. T. in *The South African Journal of Science*, Vol. XII, No. 9, pp. 237-354. Capetown, April, 1916.

Investigations undertaken in the last quarter of the nineteenth century have shown that the active principles of snake venom are soluble proteins belonging to the same class as enzymes and toxins; they have also proved that the immunisation of animals against bites can be effected in the same manner as against contagious diseases, and that the serum of immunised animals possesses specific antivenomous properties. A classified list of venomous snakes and a description of the venom organs (glands, canals and fangs) are given.

The quantity of venom which can be obtained from a snake at one time depends on a number of factors, namely : the species, the condition and size of the individual, the length of time which has elapsed since the last meal, and the interval since its last bite ; this quantity is also influenced by the

duration of the eventual captivity of the snake. The largest quantity can be obtained from the king cobra and the smallest from some species of *Hydrophinae*. From a cobra (*Naja Haje*) 200 mgms. of dried venom, corresponding with 670 mgms. of the fresh substance, have been obtained in the course of an experiment which lasted four months.

The principal physical characteristics of the venoms, which vary greatly according to the species; colour, taste, state after drying, and solubility, are described. The general action of venoms is then considered and after a recapitulation of the different researches on the question, the conclusion is drawn that these products are very complex liquids containing some of the following constituents, all of them not being present in every venom.

1) *Neurotoxins.*

a) Acting principally on the respiratory centre.

b) Acting principally on the vaso-rotatory centre.

c) Acting principally on the nerves and the discs of the fibres of the striated muscles, particularly of phrenic muscles.

2) *Agglutins.*

3) *Cytolysins.*

a) Haemolysins.

b) Leucolysins.

c) Haemorrhagins.

4) *A fibrin enzyme.*

5) *A proteolytic enzyme.*

6) *Antibactericide substances.*

The neurotoxins constitute the most active principles of most venoms.

The effects of the bite of venomous snakes are then described. The neurotoxins, which have an affinity for the respiratory centres, predominate in the venom of the *Colubridae*. This class, of which with regard to the action of the venom, *Naja tripudians* is typical, produces general paralysis with a specific paralysis of the respiratory mechanism. In the venom of the *Viperidae* the toxins acting on the blood and circulatory system predominate; this venom, particularly that of *Vipera russellii*, acts on the blood and circulatory system producing a sudden appearance of various symptoms, with a tendency to an extension of the gangrenous destruction from the local lesion, if the animal survives the acute stage.

The first scientific attempt to immunise against snake venom was made in 1887, SEWALL having then immunised pigeons by small repeated doses so that they were afterwards able to withstand ten times the fatal dose of *Crotalus* venom. In 1892 CALMETTE employed venom heated at 80° C. to immunise rabbits, but his serum, being originally from *Colubridae*, had but little action for the *Viperidae*. Pure specific sera have since been prepared by others, for example:

Lamb's serum, derived from ***Naja tripudians*** (strongly antitoxic against cobra venom).

Lamb's serum, derived from ***Vipera russellii*** (anti-toxic against *Viperinae* venom).

Noguchi's serum, derived from *Crotalus* (anti-toxic against *Viperinae* venom, but without effect against cobra venom).

Noguchi's serum, derived from *Ancistrodon* (anti-toxic against *Viperinae* venom but not against *Colubrinae* venom).

Attempts have been made with some success, to prepare a polyvalent serum, without however as yet, providing one sufficiently polyvalent to satisfy all requirements.

Practical details of the way of preparing the serum by Calmette's method and by the Watkins-Pitchford method, used in Natal, are given. In order that the estimation of the efficacity of the serum should be valuable, the minimum fatal dose of the venom must be known and this varies with each snake. The following table, resulting from a series of experiments carried out in the Pietermaritzburg laboratory and made on the commonest snakes of South Africa, is published.

Snake.	Animal employed	Minimum fatal dose per kg. of animal employed. Intravenous injection.	Hypodermic injection.
Bitis arietans	Rabbit	0.5 mgms.	1.7 mgms.
Dendrastis sp.	"	0.225 "	0.325 "
Naja nigricollis	"	0.9 "	1.25 "
Naia flava	"	1.5 "	2 "
Causus rhombeatus	"	4 "	7.5 "
Sepedon haemachates	"	0.21 "	3 "

The Pietermaritzburg laboratory has prepared a polyvalent serum against the venoms of the mamba, the puff adder (*Bitis arietans*) and the cobra (*Maja* spp.). According to the writer the preparation of a polyvalent serum requires much time; moreover the animal which should have been hyper-immunised is likely to die, and finally the serum obtained has not always a satisfactory efficacity towards all its components. It is preferable to prepare a polyvalent serum by simply mixing the monovalent sera of maximum strength.

87 - **Deraiophoronema cameli, a New Species of Filaria from the Camel's Lung** — ROMANOVITCH, in *Comptes rendus des séances de la société de Biologie*, Vol. LXXIX, No. 15, pp. 745-746. July 1916.

In the Kirghiz steppe two cases of the death of a camel have been recorded, caused by a new filaria of the lungs. The parasite has been investigated at the Veterinary Laboratory of Petrograd and named *Deraiophonema cameli* n. g. n. sp.

88 - **Metabolism of the Organic and Inorganic Compounds of Phosphorus.** — FORBES, E. B., in collaboration with BEEGLE, F. M., WHITTIER, A. C., FRITZ, C. M., COLLISON, R. C., WOODS, H. S., and KNUDSEN, C. W., in *Ohio Agricultural Experiment Station, Technical Series, Bulletin* No. 6, 80 pp. 23 fig. Wooster, Ohio, 1914. FEEDS AND FEEDING

This comparison of the nutritive value of different phosphorus compounds was undertaken as part of a general study of the metabolism of inorganic substances in relation to the practical feeding of man and animals.

The experiments were made on pigs, with normal standard rations, composed principally of relatively simple manufactured products of vege-

table and animal origin (hominy, which consists of decorticated and germ free maize grains, blood albumen, wheat gluten, maize bran, and agar-agar) to which the phosphorus compounds have been added in the form of almost chemically pure substances. All the rations also contain sodium chloride. The writers have noted that the results cannot be extended to the same compounds when found in foods under natural conditions. Moreover it is stated that according to the literature the lecithins and phosphoproteins (not included in these experiments) have higher nutritive values than all the compounds here studied, *i. e.* phosphates, hypophosphites, nucleic acid, phytin and the glycerophosphates.

Five experiments were made. The first (April and May 1908) consisted of a metabolism experiment lasting ten days made with four pigs; the second (November to December 1908) consisted of a feeding experiment (56 days) and analyses of the carcases (30 pigs); the third and fourth (November 1909 to January 1910) were of the same type as the second and were performed with 35 and 45 pigs respectively; lastly the fifth (March to June 1913) was a carefully controlled series of experiments of metabolic equilibrium for the comparison of glycerophosphates and phosphates which was completed with a slaughter test and the thorough chemical study of the carcases of the six subjects experimented with.

The results are given in numerous comprehensive tables and are summarised and discussed in the following manner.

The results of experiment I show clearly that the phosphorus of orthophosphates, hypophosphites and the nucleic acid of beer-yeast, added in a pure state to rations poor in phosphorus but capable of maintaining the phosphorus equilibrium, can be absorbed by pigs and retained in the organism in considerable quantities for at least ten days. It has certainly not been proved that each of these compounds can be permanently retained, but that seems quite probable. In the case of the hypophosphites this would necessitate a further oxidation of the phosphorus to the form of orthophosphate.

In the conditions of experiments II, III and IV, some results suggest that, from a nutritive point of view, the glycerophosphates would be superior to the orthophosphates, nucleic acid, phytin and hypophosphites, especially in respect to the proportion of muscular tissue and fat in the increase of live weight, and the breaking strength of the bones and their ash-content per cubic centimetre; but the facts are not sufficiently concordant to establish this conclusion firmly.

It is concluded from the results of experiment IV that the mineral constituents and the ethereal extract of the blood are notably affected by the diet, which also modifies considerably the salts composing the bones, both as to their quantity and their relative proportions.

Experiment V gave a very uniform and consistent series of observations of different kinds, proving that, anyway in the artificial conditions of the experiment, there are no essential differences in the mineral metabolism the digestibility of the food, and the amount and composition of the growth of swine, as affected by phosphates and glycerophosphates. It seem

ite possible that the amount of exercise taken by the pigs, as determined nply by the state of feeling induced by the ingested phosphorus com- unds, quite independently of the fundamental nutritive effects, may have ttered into the determination of the relative development and even into e composition of the different parts.

Certain differences observed in the composition of the tissues can be tributed to variations in the liquid content of the parts, the salts varying ccordingly, or to the composition of the supporting structures, or the un- rganised nutritive matters.

While the hypophosphites, nucleic acid and phytin have not been sub- itted to so complete a study as that devoted to the comparison of the hosphates and glycerphosphates, no fact having led the writers to investi- ate the question, they consider that when added in their ordinary "chemi- ally pure" form to rations poor in phosphorus such as those studied, these ve compounds do not differ in their nutritive effects on the gross compo- ition of the growth of the animals, except in so far as affected by the rela- ive tolerance of the pigs towards these preparations and the consequent nfluence on the spirits and activity of the animals.

The writers think it possible to arrange the compounds in decreasing rder of toleration, thus: glycerophosphates, phosphates, phytin, nucleic cid (from beer-yeast) and hypophosphites, the compounds being adminis- ered in doses containing equal amounts of phosphorus; nevertheless the rder of the last two compounds is uncertain. It has not been shown that hese differences in acceptability were directly related to the fundamental utritive effects. If they have been established for the chemically pure ompounds they certainly do not exist in foods containing these compounds ombined naturally.

When phosphorus is added to a ration in the form of very soluble com- ounds a much smaller amount will be tolerated by the animal than when he phosphorus is supplied in its natural form in food.

Owing to the great difficulty of making the animals eat the nucleic cid, commercial phytin and the corresponding compound obtained from heat-bran, it is concluded that the isolation of such compounds from the atural products, alters at least their therapeutic effects. So that it is mpossible to draw any conclusion on the nutritive value of these compounds resent in ordinary food from experiments made with the pure extracted ubstances.

It has not been established that the organic compounds used in this vestigation have a higher feeding value than that of inorganic compounds f phosphorus. No fundamental differences in the nutritive value of the ompounds of phosphorus studied were established. No basis therefore, as discovered for a differentiation between the nutritive values of organic nd inorganic compounds of phosphorus generally.

Even admitting debated superior nutritive value of organic phosphorus ompounds, there is no doubt that the quantity of organic phosphorus con- ined in the body is a very small part of the total phosphorus, and it is cer- in that in the diet of all omnivorous and herbivorous animals (*i.e.* of all

domestic animals) there is a much greater ratio of organic to inorganic phos phorus, than in the bodies of these animals. Therefore each time it i necessary to increase the total quantity of phosphorus of a ration this re sult can be completely achieved by giving the phosphorus in the form o inorganic compounds.

It appears improbable that, for young or adult animals, any diet what ever, composed of natural foods and satisfying the nitrogen requirement will fail to furnish enough phosphorus to maintain the equilibrium of thi element. It is however certain that many rations composed of common foods do not contain the quantity of phosphorus necessary to assure the ma ximum assimilation of this element and the maximum development.

The results of the experiments indicate that the possibility of influenc ing to a practical extent, the relative development of the tissues and organs of domestic animals by adding isolated compounds of phosphorus to the ra tion, is probably limited to the density and strength of the bones. How ever, the increase of the resistance and density of the bones obtained by adding phosphorus compounds to the normal diet is accompanied by only a small possible increase in the external dimensions.

In order to increase the strength of the bones of growing animals, the most practical form in which to administer the phosphorus for this purpo is probably any preparation of bone readily eaten by the animals. Preci tated bone phosphates are readily taken by all kinds of farm stock.

The diets experimented with were deficient in phosphorus and calci but the animals possessed quite a limited tolerance towards each of the elements in the form of their pure salts. The addition of marked quantit of calcium carbonate always produced digestive troubles ; although the d ficiency in phosphorus was such that the bones were quite insufficient nourished, it was not possible to administer more than 25 to 40 per cent the total phosphorus in the forms it was desired to study. The attem to increase the mineral base of the rations by the addition of potassiu and sodium citrate were no more successful.

1089 – **The Influence of the Nature of the Diet on the Retention of Protein.** UMEDA N., in *Biochemical Journal*, Vol. X, No. 2, pp. 245-253. London, June 1916

The question of the capacity of the organism to store protein has alwa been one of considerable interest and although it is highly probable th such a storing is a normal process, the critical conditions for its occu rence have not yet been fully elucidated, largely owing to the fact th the amount of information available from nitrogen equilibrium studies small and its value difficult to assess. Still by the use of the method superimposition results of importance can be obtained without recour to such favouring conditions of storage as muscle work, growth or ina tion, all of which conditions introduce secondary factors which render t interpretation of the data more difficult.

In the course of another investigation Tsuji (1915) found that t degree of retention of superimposed protein varied (1) with the nature the standard diet, and (2) with the nature of the protein superimpos As these experiments were, as regards the superimposition, only of o

day's duration the present series of experiments was carried out to amplify the data obtained.

The animal employed was an Airedale bitch weighing 17.6 kilos. She was fed daily at 11 a. m. after catheterisation, the urine then obtained being added to the urine collected in the receiver of the metabolic cage.

The analytical methods employed were: total nitrogen, Kjeldahl; urea, Plimmer and Skelton's modification of the urease method, ammonia, Folin. The delimitation of the faeces was carried out by means of charcoal or carmine. The total faeces was collected for each period and a single analysis of the mixed specimens was made.

As regards the standard diets employed three different combinations of protein, fat and carbohydrate were used. They all contained the same amount of protein and were of the same caloric value but varied markedly in their content of fat and carbohydrate. They were as follows.

I. *Carbohydrate-rich, fat-poor diet.*

Scott's oatflour . . .	=	120 g.		
Dried skimmed milk	=	43 g.		
Margarine	=	34 g.	Nitrogen . . .	7.2 g.
Caseinogen	=	19 g.	Carbohydrate. .	194 g.
Tapioca		93 g.	Fat	34 g.
Sodium chloride . .	=	2 g.	Caloric intake .	1206

II. *Intermediate diet.*

Scott's oatflour . . .	=	60 g.		
Dried skimmed milk	=	62 g.		
Margarine		77 g	Nitrogen . . .	7.2 g.
Caseinogen	=	10 g	Carbohydrate. .	117 g.
Tapioca	=	47 g.	Fat	68 g
Sodium chloride. . .	=	2 g.	Caloric intake .	1296

III. *Fat-rich carbohydrate-poor diet.*

Scott's oatflour. . .	=	30 g.		
Dried skimmed milk		40 g.		
Margarine	=	120 g.	Nitrogen. . . .	7.2 g.
Caseinogen.	=	34 g.	Carbohydrate. .	42 g.
			Fat	101 g.
Sodium chloride .	=	2 g.	Caloric intake .	1296

The standard diet was continued for a pre-period of five to eight days until the nitrogen output was approximately constant, there was then added to the diet a definite amount of protein material, and this was continued for eight days when the diet again reverted to the original standard for a post-period of six or eight days. It was thought that in this way some definite information as regards retention would be obtained.

A short bibliography is given and tables show the results of the five experiments, which were as follows:

Experiment I. Retention of caseinogen nitrogen on the carbohydrate-rich fat-poor diet.

Experiment II. Retention of caseinogen nitrogen on the intermediate diet.

Experiment III. Retention of caseinogen nitrogen on the fat-rich, carbohydrate-poor diet.

Experiment IV. Retention of gelatin nitrogen on the carbohydrate-rich, fat-poor diet.

Experiment V. Retention of gelatin nitrogen on a fat-rich, carbohydrate-poor diet.

The conclusions were as follows:

1. Nitrogen in the form of protein added to a carbohydrate diet is retained in greater amount than when added to a fat diet of equal caloric value.

2. Nitrogen given in the form of caseinogen is more completely retained than when given in the form of gelatin.

3. The addition of meat extract to gelatin does not increase the amount of nitrogen retained.

The paper does not deal with the problem as to how the carbohydrate acts, but it will possibly be treated in another paper.

1090 – **The Influence of Phosphates on the Feeding of Cattle.** — PICCININI MARIO in *La Clinica Veterinaria*, 39th year, No. 13-14, pp. 383-391. Milan, July 30, 1916.

Investigations were carried out on the influence which the different compounds of phosphorus have on the growth of young animals. As it was intended to treat the latter from their birth, a preliminary investigation was made to determine whether it is possible to influence the amount of phosphorus in the milk of the mothers by the administration of different phosphorus compounds. This preparatory work was carried out on three cows belonging to the Zootechnic Institute of the Royal Veterinary School of Naples. The phosphorus was administered in the form of bone powder (23 per cent phosphoric acid), dicalcic and tricalcic phosphate (44 per cent phosphoric acid), calcium glycerophosphate (25 per cent phosphoric acid) and a cereal decoction. During the course of the investigation the three cows always received the same diet. The milk from each stage was exactly weighed, from it a sample proportional to the quantity produced was withdrawn and this was employed for the estimation of the phosphoric acid.

The trials covered five periods, each of which can be divided into three parts. In the first, lasting eight days, the animal received the ordinary diet and this period served to render constant the phosphoric acid content of the milk produced. In the second, lasting from three to six days, the compound, of which it was desired to determine the influence, was administered. In the third, lasting eight days, the feeding reverted to the normal and the administration of phosphorus was suspended. The last period served to indicate how long the influence of the phosphatic substance administered in the preceeding period persisted.

From the amounts of phosphoric acid found in the milk before, during

and after the administration of the different phosphates to the animals it seems that certain slight modifications can be effected in the phosphoric acid content of the milk. However, the administrations have no fixed influence and do not produce a constant regular increase proportional to the quantity of phosphate administered, on the contrary they seem almost to exercise a disturbing influence. Indeed, whilst an unexpected uniformity in the phosphoric acid content of the milk produced by the animals under observation is observed before the phosphates have been administered to them, this uniformity ceases three or four days after the first administration.

Thus, in the eight days which preceded the first administration of bone powder (150 gms. the four first days and 200 gms. the two last) to cow No. 1, the phosphoric acid content of its milk varied from a minimum of 2.8 per cent to a maximum of 2.94 per cent, but on the third day after the first administration of bone powder, there was a marked depression in the phosphoric acid content (2.63 per cent) which increased the following day (3.24 per cent) and then underwent a new and considerable depression (2.02 per cent). These alternate high and low figures continue for seven or eight days from the last administration of bone powder. Almost the same observations were made with cow No. 2. Uniformity in the phosphoric acid content (3.04 per cent to 3.45 per cent) of its milk before the tricalcic phosphate had been administered, a depression (2.63 per cent) the third day after its administration (80 gms. per day for seven days) then the oscillations, which however did not extend above the preceding mean content, and finally, seven days after the last administration, a reversion to the original regular and constant figure. With cow No. 3 there was a marked increase in the phosphoric acid content of its milk on the third day after a single administration of 200 gms. of dicalcic phosphate. The content reached 3.28 per cent although previously it oscillated between 2.84 per cent and 2.95 per cent. Then there were alternate increases and decreases, and only after seven days did the phosphoric acid of the milk revert to within the limits of the original mean value.

Calcium glycerophosphate gave the same result, the experiment being made four months after that with bone powder. The third day after its administration to cow No 1 a depression in the phosphoric acid content of its milk was evident ; the amount decreased to 2.84 per cent, although it had previously oscillated between 2.99 per cent and 3.19 per cent ; this depression was maintained on the following days, and it was only on the fifth day after the first administration of glycerophosphate (the third from the last administration, when twice the preceding quantity – 200 gms. – was given) that there was a slight increase above the ordinary content (3.29 per cent) ; then there was a fresh depression which, always less marked, was maintained the whole time that the estimation were made.

The same results were obtained by administering to the same cow cereal decoctions containing from 0.56 to 1.1 gms. of phosphoric acid per litre. The second day after the first administration a large decrease in the phosphoric acid content of the milk (from 3.29-3.26 per cent to 2.68 per

cent) was observed ; this depression was maintained on the two following days. On the fifth day after the first administration, the second from the last dose, there was a slight increase. The ordinary constant acid content reappeared only after seven days from the last administration of the cereal decoction.

1091 – **Stallion Service in the United States.** — WENTWORTH E. N., (Kansas Agricultural College), in *The Breeder's Gazette*, Vol. LXX, No. 5, p. 169. Chicago, August 3, 1916.

Of the twenty-two States which possess a government stallion service, nineteen have published the statistics respecting it, *i. e.*, New York, New Jersey, Pennsylvania, Michigan, Indiana, Illinois, Wisconsin, Iowa, Minnesota (1), North Dakota, South Dakota, Nebraska, Kansas, Utah, Montana, Idaho, Washington, Oregon and California. The report gives the distribution of the stallions amongst the different breeds, as shown in the following table :

Breeds	Pure blood stallions	
	Number	Percentage
Percheron	18 022	53.225
Standardbred	4 214	12.445
Belgian	4 091	12.082
French, heavy	2 116	6.249
Shire	2 104	6.214
Clydesdale	1 270	3.751
German carriage horse	502	1.483
Shetland pony	302	0.892
Morgan	296	0.874
Hackney	273	0.806
English thoroughbred	233	0.688
French carriage-horse	181	0.535
American saddler	120	0.355
Suffolk	60	0.177
Cleveland Bay Trotters	25	0.074
Non Standard Trotters	25	0.074
Arab	18	0.053

Obviously the heavy horses are in a large majority (81.72 per cent.) those of the light type only representing 18.28 per cent. Besides these 33 86 pure bred stallions, 23 151 grade stallions are authorised and approved for the stallion service. These represent only 38.05 per cent of the entire number of stallions employed.

1092 – **The Very Short Gestation of a Mare.** — DE CHOIN, in *Comptes rendus de l'Académie d'Agriculture de France*, Vol. 1, Year 1915, No. 25, pp. 716-717. Paris, 1916.

This note records observations on a mare, Walkyrie, which was served on March 19, 1915 and foaled on November 7, 1915, after only 233 days of pregnancy. The offspring, which was perfectly viable, weighed 128 lbs. and had a height to the withers of about 36 ins. The only appa

(1) See *B.* Sept. 1916, No. 993.

ent incomplete part at birth was the epidermis of the feet which grew ra-
idly during the first few days of the foal's life. This authoritative case
onsiderably reduces the 287 days previously recorded as the minimum
eriod of gestation for a mare.

093 - **Origin of the Brazilian Breed of Cattle "Caracu".** — ROMAO J. J. in *O Criador Paulista*, 11th year, No. 7, pp. 179-184, 11 fig. Sao Paulo, July, 1916.

The "Caracu" breed was founded by the great-grandfather of the
riter. Joaquim Bernardes de Costa Junquiera at Rio Verde (Minas Ge-
aes) by crossing the cattle named "Junqueiros" in the State of Minas,
Franqueiros" in the State of Sao Paulo, and "Colonia" in that of Bahia,
ith the cattle "Curraleiro". At that time the "Junqueiro" and the
Curraleiro" constituted two distinct types. The breed "Junqueiro"
as descended from the Portuguese "Alentejana" imported from Portugal
nto the southern part of the State of Minas, where it developed much more
han in the country of its origin. The "Curraleiro" breed is of Spanish
rigin, the first examples imported into Matto Grosso and to Goyaz came
om Uruguay and the Argentine. The cattle "Caracu" has been inbred
nd selected by three generations of cattle-breeders. It has been brought
a very high degree of perfection and constitutes to-day a constant and well
efined type. According to the writer it would be expedient to breed
pure instead of crossing it with the zebu, as is almost universally done
the State of Minas Gereaes, for the offspring of the cross is much less sa-
sfactory than the pure "Caracu".

094 - **The Ration and Age of First Calving as Factors Influencing the Growth and Dairy Qualities of Cows.** — ECKLES C. H. in *University of Missouri College of Agriculture Experiment Station, Bulletin* No. 135. Columbia, Missouri, September, 1915.

This investigation was made to obtain data on two points (1) the in
ence of liberal as compared with light rations during the growing period,
the influence of the age at first calving. It was desired to ascertain more
finitely the relation of these factors to the dairy qualities of the cow.
e data obtained were also expected to have an important bearing on the
ation of these factors to dairy type, rate of growth, age at maturity and
te of sexual maturity.

A list of questions relating to these was sent to the most important
eders of dairy cows. Three hundred answers were received and have
en tabulated. These indicate a wide range of opinion as regards such
ints as the relation of age at first calving to type, milking qualities and
e, the effect of heavy grain feeding during the period of growth upon
e, milking qualities and type.

The experiments lasted eight years and were made with forty pure-
d cows of the Jersey, Holstein and Ayrshire breeds. Complete records
the food they consumed and their development as shown by skeleton mea-
ements and the weight, were kept from birth to maturity. The milk
oduction was recorded for each cow during two or more periods of lacta-
n.

The forty cows were divided into two principal groups. The first was

given a heavy ration from birth to first calving, the second a light ration The heavy ration consisted of whole milk during the first six months, or an average 16 lbs. per head per day, and all the grain (corn two parts oats one part) and hay the animals would consume up to the first calving During the summer a number of these animals were kept grazing and received in addition the grain ration, others were not put on pasture but received the hay and grain all through the year. After calving all the cows had alfalfa, hay, silage and a grain mixture of four parts of corn, two of bran and one of oilmeal, administered proportionally to the milk production of the animal. The light fed group received the mother's milk during the first fortnight, this was then gradually replaced with skim milk, fed warm and sweet immediately after separation, until the end of six months. Alfalfa hay was given as soon as the animals would consume it. Grain was only given from the time when milk production commenced. In the summer a number of the animals was put on pasture, while the remainder received only hay and a little green soiling crops. After calving all the cows of the second group received the same ration as those of the first.

The factor of age at first calving was introduced by taking care that half the cows of each group calved at an early age for the breed, and the other half about a year later.

Influence of ration upon rate of growth. — The weight and skeleton measurements were determined every month. The effect of the heavy feeding was a more rapid development of the skeleton especially during the period when growth is most rapid. Later it produced a much greater fattening. The animals which were lightly fed grew less rapidly but for a longer time; nevertheless they never attained a size equal to that of the first group. The difference between heavy feeding and light feeding for the young animals shows more strongly upon the weight than upon the rate of skeleton growth. One cause of the existence of small cows in commercial herds is the character of the ration during the growing period.

Influence of the age at first calving on the size. — This factor has a marked effect on the size of cows. Milk production imposes a heavy tax on the cow and checks the growth in a very decided way. On the other hand gestation does not sensibly hinder its development. The most important factors which tend to limit the size of cows are scanty feeding during the growing period and early breeding.

Sexual maturity. — The ration exercises a considerable influence on the time of sexual maturity. Animals fed heavily mature sexually when two to four months younger than animals fed lightly.

Relation of ration to dairy qualities. — The heifers heavily fed during growth were slightly inferior in milk production, to those fed lightly. The employment of heavy grain rations seems to have had some detrimental effect on the milking functions. But, within the limits ordinarily existing in practice, this factor probably has no appreciable influence. Some high producing cows were found in each group, and also some medium and some inferior. The data indicate that the hereditary factors such as the influence

of the sire and the individuality of the animal are the real determining factors with reference to the milking functions of the cow. Inferior milk-producing cows are rather the fruit of heredity than of the treatment received when they were young.

Age of calving and milk production. — The experimental data given and a compilation of the records of the University of Missouri herd for twenty-two years show that on an average the maximum production of milk is secured from cows well matured before they commenced lactation. The maximum production among ninety-five cows was obtained from those calving between the ages of 28 and 32 months, the minimum from those calving under 20 months old.

Relation of ration to dairy type. — Heavy feeding of young cows tends to produce larger and rather coarser animals than does light feeding. At the time of calving the conformation of the animal bred on heavy grain ration is somewhat different from that of one bred on a ration of roughage. If both cows are given the same ration after calving, this difference soon disappears.

Age of calving and dairy type. — Early calving tends to produce a smaller and more refined type of cow than that which results from calving a year later.

Relation of roughage fed to digestion. — The opinion of breeders is that a cow bred principally on roughage has a greater capacity for the elaboration of the food when it reaches maturity. This opinion has not been confirmed by the writer's investigation. For a short time after calving there was a marked difference, but this disappeared gradually and two months later there was no difference between the two groups. It was proved that the animals of the two groups required the same quantity of nutrients to produce a pound of milk.

Conclusion. — It is possible to influence, to some extent, the rate of growth, the size when mature and the type of cows, by the liberality of the ration during the period of growth, and by the age at first calving. Even within limits of variation much wider than normal, the character of the ration, with reference to the amount of nutriment that it yields, has no appreciable effect on the milking functions of the cow when it has reached maturity.

The age at first calving is a factor of some importance with respect the development of the milking functions of the cow. Calving at very early age prejudices the best development of the milking function nd nothing is gained by retarding it too much.

95 - **The Cost of Food in the Production of Milk.** - - CROWTHER Ch. and RUSTON A. G. in the *University of Leeds and Yorkshire Council for Agricultural Education Bulletin* No. 98, pp. 1-37. Leeds., 1915.

During the four years from April 1911 to March 1915, a continuous ries of investigations on the cost of feeding cows, and the yield and uality of the milk produced by them has been carried out on a number farms in the North Riding of Yorkshire.

The present report deals with the data obtained during the twelve

months from April 1, 1914 to March 31, 1915. As in previous years each herd has been visited fortnightly by the Recorder for the purpose of weighing, sampling and testing the morning and evening milk of each individual cow. At each visit he has ascertained also the amount and nature of the food consumed by the cows and has obtained from the farmer particulars as to the breed, age etc. of each cow. During the year 291 cows were tested, but for only 144 of these have complete records for the twelve months been obtained. The climatic conditions have a considerable influence both on the grazing and on the hay crop; and therefore also on the cost of the food consumed; accordingly the meteorological data for the five summer months are given. The great variations of temperature in May, and the unusually severe night frosts checked the growth of grass to such an extent that the pastures were bare until late in the summer and the hay crop distinctly light.

The report deals first with yield of milk then with the nature and amount of feeding (including cost) and finally with the percentage of fat in the milk.

The data for 1914-1915 are compared with those of the preceding years, the cows being divided into eight classes according to their yield as follows:

TABLE I.

	Number of cows giving milk yield (gallons) for 12 months							
	400 or less	401–500	501–600	601–700	701–800	801–900	901–1000	Over 1000
1914–1915	13	19	19	30	24	19	11	9
1913–1914	11	17	22	35	28	14	5	9
1912–1913	7	14	22	25	19	11	7	4
1911–1912	9	8	20	15	15	10	11	7
Total 4 Years	40	58	83	105	86	54	34	29

Great differences are again noticeable between the average yields of the various herds and still more between the records of the individual cow within each herd. The maximum average yield per head was 935 gallons, the minimum 472 gallons.

The average weights of food consumed and the duration of the pasturage per head in 1914-1915 and 1913-14 were as follows:

Although the mean consumption per annum was almost the same in the two years, close examination of the figures given in the original shows that the system of feeding has differed greatly as between the various herds. In view of these differences the amount of digestible proteins, and the starch equivalent of the food actually fed per day were compared with the

TABLE II.

	Grass	Hay	Straw	Roots	Cake and meal
	weeks	tons. cwt. st.	cwt. st.	tons. cwt. st.	cwt. st.
verage 1914–15.	27	19 3	12 6	4 9 3	17 5
" 1913–14.	28	1 5 2	12 4	4 0 2	17 7

rotein and starch required according to standard for the production of he milk obtained. The average amount of digestible protein fed was .98 lbs. per day, that required 2.04 lbs. ; the average starch equivalent f the food fed was 12.83 lbs., that required 11.64 lbs.

As in previous years the home grown foods were valued according o the following arbitrary scale.

Hay	£2 15s per ton.	Swedes	10s 0d per ton.
Oat Straw	£1 10s "	Mangels	10s 6d "
Barley Straw	£1 5s "	Turnips	8s 0d "
Grass	3s 6d per week for spring calvers.		

These prices are probably on the whole, rather higher than the bare st of production and represent what may be termed the feeding or nsuming value. The purchased foods were taken at full cost without y deduction for the value of the manurial residues arising from the nsumption.

The estimated average cost of feeding per cow per annum was as follows.

TABLE III.

	Estimated cost per cow per annum					
	Grass	Hay	Straw	Roots	Cake etc.	Total
verage.	£4 15s 5d	£2 11s 4d	17s 10d	£2 3s 11d	£5 0s 9d	£15 15s 3d
r cent	30	16,5	5,5	14	34	100

There were considerable variations from the mean, the maximum cost food per head being £ 20 10s and the minimum £ 13. The hay and grass present on the average one-half, the arable crops one-fifth and the rchased foods one-third of the total cost, results in close agreement with ose found in previous years.

Of the total number of cows 42 did not yield milk equivalent in value the estimated cost of feeding when the milk was valued at 6*d* per gal-n, 24 per cent when the value was 7*d* per gallon, 15 per cent when 8*d* per llon, 10 per cent when 9*d* per gallon and 7 per cent when 10*d* per gallon.

Assuming that 100 gallons of whole milk give roughly 90 gallons of nt milk and valuing the latter at 2*d* per gallon, then deducting the value

of the skim milk from the full food bill of each animal, values were obtained for the cost of food per pound of butter fat produced. These values varied from a minimum of 5.5*d* to a maximum of 14.9*d* per pound with a mean of 9.4*d*.

The variations of the percentage of fat deserve special mention. The following table gives a summary of the data for 260 days.

TABLE IV.

Number of samples of which the percentage of fat lies between	Morning milk	Evening milk	Average
2,6 to 2,79	5	0	0
2,8 to 2,99	9	0	0
3,0 to 3,19	47	1	1
3,2 to 3,39	56	2	9
3,4 to 3,59	47	14	42
3,6 to 3,79	36	13	77
3,8 to 3,99	22	28	60
4,0 to 4,19	9	48	43
4,2 to 4,39	9	49	9
4,4 to 4,59	5	40	4
4,6 to 4,79	3	27	4
4,8 to 4,99	4	21	3
5,0 and above	8	17	9

The considerable difference between the percentage of fat in t morning milk and the evening milk is due to the difference in the time elap ed since the preceding milking. The greater the difference between t day and night intervals, the greater is the difference in the mean fat co tent of the milk at the two milkings.

1096 – **Feeding Trials of Dairy Cows in Denmark.** — LUND, A. V. in 89th *Compte rendu du Laboratoire d'essais de Copenhague* (communicated to the International Institute Agriculture by its Danish Correspondent, Baron ROSENKRANTZ).

A. *Trials with Mangels and Turnips.* — The trials were intended t compare the feeding value of mangels and turnips, and also the amoun of dry matter of the kinds moderately rich in this constituent, *e. g.* mangels Barres' Ovoid and Eckendorf; turnips, Baugholm and Superlative. Th results of three groups (I, II, III) of experiments are given.

I. *Comparison of Mangels and Turnips Having the Same Content o Dry Matter.* — In each experimental farm two groups of uniform co submitted to the same feeding during the preliminary period, we

chosen. During the trial period one of the groups received a certain amount of dry matter from mangels, the other a corresponding quantity from turnips; in the post period the two groups were fed in the same manner. In the trial period 79.8 lbs. of mangels (9.3 lbs. of dry matter) were on an average replaced by 84 lbs. of turnips (9.26 lbs. of dry matter). The group fed on mangels produced, during the trial period, a little more milk than that fed on turnips, whilst in the periods before and after the trial, when the two groups received the same diet, the milk production was the same. The mean increase of milk yield for ten cows was 7.27 lbs. per day, or about 2.5 per cent. On the other hand, the percentage of fat in the milk, which in the preparatory period was equal in the two groups, diminished slightly during the trial period in the milk from the group fed on mangels, but increased again in the post period. This was only a matter of some hundredths of one per cent, so it is not easy to determine what significance should be attached to the difference. The change of diet had no influence on the composition of the milk or on the general condition of the different groups.

II. *Comparison of Roots (mangels and turnips) Having a Comparatively High Content of Dry Matter.* — The trials were made as described above. The different roots contained the following amounts of dry matter:

	Mean content per cent	Maximum content per cent	Minimum content per cent
Mangels:			
. . . . .	13.4	14.39	11.43
Barres' Ovoid	12.49	13.67	9.12
Eckendorf	9.97	10.67	8.12
Turnips:			
Bangholm	11.52	12.27	10.56
Superlative	9.57	9.80	9.16

The animals were given on an average 8.5 lbs. of dry matter per head day; for this purpose 70.3 lbs of the roots having a high content of matter, and 74.6 lbs of the roots having a low content, were required. The nett result showed that the difference in feeding affected neither the quantity of milk, nor its composition, nor the general condition of the animal. In other words, a difference in the content of dry matter produced no difference in the forage value of the roots.

III. *Influence of the Roots on the Quality of the Butter* — An experiment was made in a farm with two very comparable groups of cows containing six-teen in each. During a sufficient preparatory period both groups received the same ration (half mangel, half turnip). The milk from each group during several consecutive days was dispatched to a dairy where the cream was skimmed, acidified and transformed into butter under identical conditions for the two groups. Then in the trial, the feeding was modified so that the first group received 99.2 lbs. of turnips per cow, the second group 82 lbs. of mangels (giving an equal amount of dry matter). At the end

of ten days a second preparation of butter similar to the first was made, and a third eighteen days later.

During the period after the trial, the two groups received the same quantity of mangels, 88.2 lbs per head per day. Ten days later a fresh preparation of butter was made. In each case the butter was conveyed to the laboratory to be examined and judged. The butter of the two groups was found to be of the same quality, but that from the feeding with turnips had a higher iodine number and olein content than had that from the feeding with mangels. Further the former butter contained one per cent more water, and the butter milk 0.18 per cent more fat. However the treatment of the cream and butter explains these differences.

B *Trials withc Cocoa Cake.* — This by-product from the manufacture of cocoa, although only recently used in Denmark for the feeding of dairy cows, has quickly acquired the reputation of increasing the percentage of fat in milk.

The experiments lasted more than three years and were made on two groups of very comparable cows, one group being permanently fed on cocoa cake.

In the first year when the earth nut and soja cake (1.75 lbs. added to the ration) fed to the first group, was replaced by 2.42 lbs. of cocoa cake the quantity of milk diminished, but the percentage of butter-fat did not increase so as to equal that of the second (permanently cocoa fed) group. In the second year an attempt was made to ascertain the influence of the addition of 1.54 lbs. of cocoa cake, particularly as to whether the milk yield was maintained and at the same time the percentage or butter increased. But the cocoa fed group in spite of the addition of cake to the ration, gave less milk than did the other group, although this contained a little more butterfat (0.15 per cent) so that the cows of the two groups produced almost the same absolute amount of butter-fat. Just as in the preceding trial, the milk from the cocoa fed group proved to be richer in protein but poorer in sugar and ash. A similar trial made in the third year gave concordant results. Thus the principal result is an increase in the percentage of butter-fat in the milk but simultaneously a decrease in the yield of milk, so that the absolute quantity of butter-fat does not increase, even as a result of the supplementary addition of cocoa cake. Since the latter moreover modifies the composition of the milk it must be considered rather as a poison than a food, and not given to dairy cows. These results are corroborated by the data below.

C. *Poisoning by Thebromine Due to Cocoa Cake.* — Professor G. HANSEN deals with the chemical composition of this cake and describes it as containing an amount of theobromine approximately equivalent chemically and pharmacologically to the caffeine contained in coffee or tea. Cocoa beans are richer in theobromine (1 to 2 per cent) than are the shells (0.5 to 0.8 per cent) which form the greater part of the food. However the shells may also contain much theobromine as is indicated by the following data.

Professor HANSEN publishes the evidence of several veterinary sur-

geons who have made reports on the subject of poisoning by cocoa cake, which contained about 1.5 per cent of theobromine. Cases of poisoning were recorded both with cattle, where the effect initially took the form of an eczema, and with pigs and fowls where death resulted in several cases. Professor HANSEN made several laboratory experiments both with the cake and with theobromine, on fowls, rabbits and mice to determine their action on the organism. These led to the conclusion, that owing to its poisonous character, cocoa cake cannot be considered as a food.

1097- **Comparative Experiments on the Feeding of Cows with Cotton cake and Palm kernel Cake.** — *Farmer and Stockbreeder and Chamber of Agriculture Journal*. Vol XXIX New Series, No. 1403, pp. 1323-1324. London, August 11, 1916.

The Governors of the Cumberland and Westmoreland Farm School at Newton Rigg near Penrith, in their annual report, give the following particulars of experiments on the feeding of cows on cotton cake and palm kernel cake.

The dissimilarity in the composition of Egyptian undecorticated cotton cake and palm kernel cake makes it impossible to devise two rations of similar nuritive value with the same weight of each cake in the respective rations. The following were the daily rations.

Ration I		Ration II	
35	lbs swedes.	35	lbs swedes.
8	lbs hay.	8	lbs hay.
14	lbs oat straw.	14	lbs oat straw.
2 3/4	lbs decorticated cotton cake	2 3/4	lbs decorticated cotton cake.
4	lbs Egyptian undecorticated cotton cake	5	lbs of palmnut kernel cake.
2	lbs crushed oats.		

The two rations contain almost the same quantity of digestible matter, e albuminoid ratios being 1 :7 in the first and 1 : 7.5 in the second. Owing the difference in the cost of the cakes at the time, ration No. 1 st 13 *d* per week more than ration No. 2.

The experiments were made on eight cows divided into two lots, which ceived the respective rations I and II for three weeks. The rations were en reversed and at the end of three weeks were again reversed and again : the end of another three weeks, the trial thus lasting twelve weeks. he cows were weighed at the commencement and at the end of each period f three weeks. The milk of each cows was weighed morning and evening nd the fat of the mixed morning and evening milk of each lot estimated nce under each diet.

The following is a summary of the results :

	Ration I Cotton cake	Ration II Palm nut cake
Total quantity of milk produced	7749 lbs.	8157 lbs.
Gain of cows in live weight	392 lbs.	394 lbs.
Percentage of fat in the milk	3.55	3.60

Thus the Egyptian cotton cake while costing more than the palmnut kernel cake produced less milk without increasing the gain in live weight of the cows or the percentage of fat in the milk. It should be stated that the cows do not take readily to palmnut kernel cake unless it is damp with treacle solution or dusted with locust bean meal.

1098 – **Studies on the Hygienic Production of Milk: Importance and Control of the Microflora of the Udder in the Selection of Dairy Cows.** — GORINI, COSTANTINO, in *Reale Instituto Lombardo di Scienze e Lettere*, Rendiconti, Vol. XLIX, part 14, pp. 486-489 Milan, June 22, 1916.

The writer's previous investigations carried out since 1901 have established the following facts: 1) the microflora of the udder is characteristic and composed of acid-forming bacteria; 2) with these bacteria the coccus forms predominate, particularly the micrococcus (*Bacillus minimus mammae*) but bacillus forms are also met with; 3) the microflora assists both the digestion of the milk and the ripening of the cheese, by its peptonising action on the casein; 4) in some cases the microflora of the udder contains the common lactic organisms, principally of the streptococcus type; 5) sometimes, although originating in a healthy udder, it exercises a harmful action on the milk.

Subsequent investigations made in the Bacteriological Laboratory of the Agricultural High School of Milan, confirm the above results and lead also to the following conclusions.

1) The importance of the microflora of the udder increases as milking approaches the ideal condition of asepsis, *i. e.* the absence of external microbial contamination.

2) The micro-organisms of the udder are most often found grouped in albuminous clots, which not only makes their enumeration difficult, but also gives them a marked power to resist heat, although they are not sporulating.

3) The microflora of the udder is not affected by the hygienic condition of the cow-sheds, and for this reason bacterial counts of milk may not give a true indication of the cleanliness of the milking process.

4) The microflora of the udder seems to be connected with external and internal factors which still require to be investigated. With certain cows the quantitative and qualitative examination yield such persistently high results, that the condition may almost be described as abnormal though not pathological.

The writer proposes that in the selection of heifers for the production of milk, not only their state of health but also the microflora of their udders should be taken into account. Such selection is particularly necessary in the case of the so-called "sanitary milks", milked by aseptic methods and intended, both in the raw and pasteurised or sterilised condition, for the feeding of infants and invalids.

The method of examining the microflora is described by the writer. Ordinary methods of culture on artificial media cannot be employed, but the fermentation test or lactozymoscopic test is used; the latter must be

carefully standardised and should be applied to the milk obtained aseptically from each cow and from each quarter.

A bibliography of twenty-three publications is appended.

1099 – **The East Anglian Milk Recording Society** (1). — CHEVALIER, J. B. and OLDERSHAW, A. W. in *Journal of the Board of Agriculture*, Vol. XXIII, No. 5, pp. 431 to 436, London, August, 1916.

The East Anglian Milk Recording Society was established in June 914. The annual subscription was fixed at 2*s* 6*d* per member in addition) a levy of 2*s* per cow per annum — the minimum levy being fixed at £ 1 er member. The members of the Society were scattered over a very ide area, within a radius of about thirty miles of Ipswich. The milk ecorder paid a surprise visit to each herd at least once in every six weeks. le received a salary of £ 100 per annum and paid his own travelling exenses. Samples of the mixed milk of the herds were taken on each vening and morning of the recorder's visit: these samples were tested ratuitously but a fee of 3*d* per sample was charged for any addition mples tested. The Society comprises 21 members with 25 herds, divied into two classes, herds containing cows of a mixed type, and herds of ure bred cattle. At the first series of visits of the recorder 695 cows ere tested.

One of the most useful functions of the Society consists of carefully eighing the food fed to the cows of various members. The results of vestigations as to rations have been communicated to the local press om time to time, and it is hoped that in this manner, the Society in adition to helping members to select their cows and feed them cheaply, will so be of some use to all owners of milking herds in the neighbourhood.

The following table gives the principal returns collected by the recorer for the year June 28, 1914 to June 27, 1915.

		Number of cows
Total number		566
Breeds:	Shorthorn	32
	Red Poll	99
	Jersey	35
	British Holstein	66
	Crossbred	31
	Undescribed	303
Age:	One calf of three years old	61
	Four calves of six years old	132
	Aged animals	62
	Undescribed	311

(1) See *B.* March 1916, Nos. 322 and 337. (*Ed.*)

	Number of cows
Cows giving per annum	
10 000 lbs of milk	13
8 000 " " "	56
6 000 " " "	155
4 000 " " "	191
Under 4000 lbs of milk	97
Incomplete	54
Butter fat average	
Evening milk	4.2 per cent
Morning milk	3.6 per cent

A milk recording Society may be of value to dairy farmers:

1) By enabling them to eliminate unprofitable cows from the herds.

2) By providing a government certificate of milk yield, and i this way enabling purchasers of cows (or young stock from the herd) t place absolute confidence in the accuracy of the records given.

3) By enabling the farmer to have samples of his milk taken an tested at frequent intervals, so that he may know when it is in danger falling below the standard.

4) The account kept of the rations fed allows of a comparison b tween them and their cost in different herds and so enables farmers to judg for themselves as to the cheapest feeding for milk production in the case their own stock.

1100 – **The Dairy Side of the Ayrshire.** — WINSLOW, C. M., in *The Field*, Vol. XXVI. No. p. 588. New York, July 1916.

The ever-increasing interest in blooded dairy stock is very largely due t Advanced Registry Testing done by the four leading breeds. It has brough the good cows to the front, eradicated the scrub cow when practised, an has led to the investment of large sums of money in the dairy industry

Testing has given to the public a knowledge of the real value of high class dairy cows, and has revolutionised the whole dairy industry of th United States. The Ayrshire breed has perhaps benefited more than a the others. The long-held belief that the Ayrshire is a wonderful dair cow has been converted from a supposition to an absolute fact. The per fection of its conformation has never been questioned, but testing ha shown that this conformation is correlated with high production, that th breed can produce a record better than 25 000 pounds of milk and 1 000 lb of butter.

Official milk records of four cows a full year taken in connection wit carefully kept feeding records made by the owners, are given in the follow ing tables. The method of feeding employed by the breeders not onl reveals the benefit gained by the cows, but also affords a valuable objec lesson to others having cows on test.

Two-Year-Old Record.

CASTLEMAINS NANCY 4TH, 28 520.

Bred and owned by Percival Roberts, Jr. Penshurst Farm, Narberth, Pa. Born October 10, 1910. Weight 1015 lbs.

1913	Milk lbs.	Fat lbs.	Total lbs. butter for the year.	Average per cent fat for the year
August	1 327.3	46.32		
September	1 295.9	37.97		
October	1 276	45.55		
November	1 897.4	40.47		
December	1 149.7	42.77		
1914				
January	1 134.5	40.62		
February	1 107.6	41.42		
March	1 232.7	51.65		
April	1 206.4	48.62		
May	1 236.9	49.72		
June	1 193.8	50.62		
July	1 226.6	51.30		
365 days	14 494.08	547.03	644	3.78 %

6 812 1/2 quarts milk, at 6c. per quart, ... $ 498.75.

Food consumed, with cost of same.

Lbs.		Cost.
		$
880	Bran, at $26.00 per ton	11.54
1 130	Schumacher Stock Feed, at $28.10 per ton	15.87
751	Corn Meal, at $28.10 per ton	10.70
901 1/2	Oil Meal, at $31.50 per ton	14.20
413	Cotton Seed Meal, at $31.00 per ton	6.40
760	Beet Pulp, at $26.00 per ton	9.88
8 500	Silage, at $3.00 per ton	12.75
1 819	Hay, at $15.00 per ton	13.64
9 236	Beets, at $6.00 per ton	27.71
	Green Forage Crops	8.32
		$131.01

Profit for the year, $277.74

Three-Year-Old Record.

Mc ALISTER'S BETTY, 23548.

Bred and owned by Percival Roberts, Jr., Penshurst Farm, Narberth, Pa.

1910-1911	Milk lbs.	Fat per cent.	Fat lbs.	Butter lbs.
April	373.1	5.4 %	20.15	23.51
May	1 463.1	4,377	64.04	74.71
June	1 493.1	3,86	57.63	67.23
July	1 454	3,657	53.17	62.04
August	1 551.1	3,61	48.77	56.90
September	1 104.5	3,8	41.07	48.96
October	1 048.2	4,407	46.19	53.89
November	999.6	4,16	41.58	48.51
December	1 123.6	4,33	48.65	56.76
January	1 121.5	4,11	46.09	53.77
February	985.7	3,97	39.13	45.65
March	1 067	4,38	46.73	54.52
April	623.5	4,38	27.31	31.85
Totals	14 298.0	4,19 % (Mean)	581.41	678.31

6 604 quart of milk, at 5 cents per quart $330.20

Food consumed with cost of same.

Lbs.		Cost. £
943.5	Bran, at $25 per ton	11.793
875	Ground Oats, at $38 per ton	16.625
276.5	Corn Meal, at $28 per ton	3.870
906.5	Gluten Feed, at $32 per ton	14.504
224.5	Cotton Seed Meal, at $32 per ton	3.592
33.5	Oil Meal, at $36 per ton	0.603
1 300	Alfalfa Hay, at $22 per ton	14.30
2 000	Mixed Hay, at $18 per ton	18.00
5 000	Ensilage, at $3 per ton	15.00
5 000	Mangels, at $8	40.00
	Six Month's Pasture, at $3 per month	18.00
		$138.28

Profit for the year $198.12.

Four-Year-Old Record.

AUGUST LASSIE, 29581

Bred by L. A. Reymann. Owned by L. A. Reymann Estate, Wheeling, Va.

	Milk lbs.	Fat per cent.	Fat lbs.	Butter lbs.
March, 18 days.	816.6	3,69 %	30.13	35.45
April	1 898.3	3,69	70,05	82,41
May	2 146.7	3,85	82,65	97.23
June	1 898.4	3,87	73.47	86,43
July	1 716.3	4,14	71.05	83.59
August	1 544.5	4,12	63.63	74,86
September	1 392.9	4,38	61,01	71,78
October	1 371.1	4,12	56.49	66,46
November	1 235.9	4,28	52 94	62,28
December	1 261 .4	4,06	51,21	60,25
January	1 164.1	4,23	49,24	57.94
February	984.7	4,35	42,84	50,39
March, 12 days	352.5	4,35	15.33	18,04
Totals 365 days. . .	17 784.4	4,05 % (Mean)	726.03	847.11

2 272 quarts of milk, at 7 1/2 cents per quart . . . . . $ 620.40

Food consumed with cost of same.

Lbs.		Cost.
		$
1 095	Bran, at $24 per ton	13.14
1 460	Ground Oats, at $25 per ton	18.25
730	Oil Meal, at $40 per ton	14.60
1 460	Dis. Dr. Gr., at $33 per ton.	24.09
1 095	Purina, at $30 per ton.	16.42
840	Corn, at $30 per ton	12 60
2 920	Beet Pulp, at $24 per ton	35.04
9 125	Silage, at $4 per ton	18,25
2 555	Alfalfa, at $20 per ton	25.55
1 095	Clover, at $15 per ton	8 21
		$186 15

Profit for the year $434.25.

Mature Record.

GARCLAUGH MAY MISCHIEFF 27944.

Imported and owned by Percival Roberts, Jr,. Penshurst Farm, Narberth, Pa.

	Milk lbs.	Fat per cent.	Fat lbs.	Butter lbs.
December, 5 days	242.9	3,2 %	7.77	9,14
January	2 067.5	3,2	66.16	77.84
February	2 348.7	3,05	71.63	84.27
March	2 646.8	2,94	77.82	91.55
April	2 431.7	3,81	92.65	109
May	2 636.3	3,23	85.15	100.18
June	2 492.7	3,47	86.5	101.76
July	2 445.9	3,77	92.21	108.48
August	2 004.3	3,79	75.96	89.36
September	1 562.6	4,07	63.6	74.82
October	1 610.3	3,93	63.28	74.45
November	1 532.9	4,03	61.84	72.75
December, 26 days . . .	1 306.1	3,85	50.34	59.22
Totals, 356 days. . .	25 328.7	3,53 % (Mean)	894.91	1 052.83

Food consumed, and cost of same.

Lbs.		Cost.
		$
961	Bran, at $24 per ton.	11.53
1 013	Schumacher Stock Feed, at $30.80 per ton	15 60
767	Hominy, at $29.20 per ton	11.20
837	Linseed Oil Meal, at $37 40 per ton	15.63
1 066	Cotton Seed Meal, at $29 per ton	15.46
149	Gluten, at $25.40 per ton.	1 89
153	Ajax, at $33.80 per ton	2 59
668	Beet Pulp, at $26 per ton	8.60
11 200	Corn Silage, at $3 per ton	16.87
22 233	Beets, at $4 per ton	44 47
1 874	Alfalfa Hay, at $24 per ton	22.49
906	Mixed Hay, at $15 per ton	6.80
	Green Feed	4.23
		$177.46
11 780	quarts of milk at 6 cents per quart	706.80
	Profit for the year	$529.34

101 - **Sheep-raising in La Mancha, Spain : Systems of Stock-breeding Combined With Cultivation.** — SOROA, J. U., in *La Industria Pecuaria*, 17th year, No. 526, pp. 717-719. Madrid, August 20, 1916.

In La Mancha, the farms usually combine the cultivation of 170 to 50 acres of arable land with a head of stock consisting of 200 to 300 sheep or wool, about 30 pigs and 6 to 8 or 10 mules.

Rotation of Crops. — Until a few years ago little but extensive culti- tion was practised. The land was divided into three parts according to e system named " al tercio ", one remained fallow and on the other two reals were grown. Now, owing to the work of the Agricultural Advi- rs, cultivation has become more and more intensive. The systems of tation commonly employed are as follows.

A. — Vetches turned in, barley, beans, wheat. This rotation has en adopted in the Daimiel, on fresh lands in fairly good condition.

B. — Green fallow, cereal, a leguminous crop, cereal. This rotation becoming general, and excellent results are expected from it, provided at the manure applied is well rotted. The following rotation is also metimes practised: green peas (always in the spring), barley, lentils or tches, wheat or oats.

C. — Rotation for irrigated land :, pearl millet (" panizo negro ", e. *Pennisetum typhoideum*), potatoes, beans, wheat. Practised in the unicipalities of Manzanares., Daimiel and Villarrubia.

D. — The " al tercio " system, mentioned above, is the one most ten employed.

Pastures. — Once every seven years barley or oats are generally sown low forest to provide grazing for sheep. Breeding mules and sheep are so grazed on the lowland and plain pastures in the spring and autumn lunicipalities of Alcazar, Valle de Alcudia and those of the province of oledo which belong to La Mancha) ; but in the Municipality of Malagón hese pastures are intermixed with orchards of pear trees, plum trees and pricots, whilst in the province of Cuenca they are planted with alders, sh trees and sometimes willows.

Manures. — Both dung and fertilisers are used, the latter in large quanti- s for cereals. Dung is not abundant, on account of the limited number animals, and moreover it is of bad quality because there are no well- ilt manure sheds. Sheep are folded on the land.

The artificial fertilisers consist of superphosphates and various mixt- es whose composition is not stated. The price of dung is very high, £3 5s r ton without the cost of transport. The manurial value of folding estimated at 5*d* for 100 sheep passing one night on the land, which pro- le sufficient manure for 175 to 240 square yards.

Utilisation of the Products of the Trees. — At the present time scarcely ly use is made of the acacias and the few mulberry trees that exist; they ford little else but their shade. As the climate is not adapted for rearing lkworms, the mulberry leaves cannot be employed for this purpose and ere are not enough of them for export. On the other hand the State nurseries each year export an incresing number of acacias.

Disadvantages Observed. — 1) In breeding no scientific rule or definite method is followed, consequently a poor class of animal is the rule.

2) Fodder is scarce and in some seasons absolutely wanting.

3) The excessive travelling of the animals reduces their weight and production of milk.

In the region of La Mancha, sheep are bred under the two following system :

Case 1. — During the winter the ewes which have just lambed are given extra food, and when the lambs are weaned these are also fed until the time when the pastures are ready. For this purpose each ration costs more than 1.4*d* per day. The following account is given.

Receipts.

	s	d
Production of milk for 2 ½ months after weaning the lamb : 4.8 ¼ gallons at 13.1*d* per gallon	5	3.3
5.5 lbs. of wool at 6.3*d* per lb.	2	10.8
11.8 cwt. manure at 4.9*d* per cwt.	4	9.8
Value of the lamb	11	2.4
Total . . . £1	4	2.3

Expenses.

	s	d
90 days feeding the ewe, valuing the ration at only 1.4*d* (the most favourable case)	10	9.6
30 rations for the lamb at 0.8*d* per head per day		9.6
Cost of keep during remainder of the year	6	7.2
Attendance at 0.11*d* per day.	3	6.05
Interest and depreciation at 0.019*d* per day, mortality risk at 4 per cent and cost of veterinary surgeon.	2	4.8
Total . . . £1	4	1.25

Thus the conclusion is drawn that the annual profit does not exceed 1.05 *d* per head.

Case 2 — Rearing being impossible, the lanbs are sold directly ; they are bought by middlemen at a low price, and it must be acknowledged that the loss on the side of the lambs is balanced by the gain in the production of milk, so that the nett result is the same as in the preceding case.

Conclusion. — From the above it is concluded that the best method of sheep-raising is to select the breed of La Mancha and cross it so as to obtain animals which can be weaned promptly and employed in the production of cheese. The latter substance keeps for a longer time than does milk or mutton, and the profit is not lowered by the demands of middlemen. Then cheap fodder must be found for the winter ; the rations should not cost more than 0.7*d* per head per day. Where this is not possible, improved breeds of great hardiness must be obtained for crossing with the breed of La Mancha, so as to resist the adverse conditions in times of a shortage

102 - **The Poland-China Breed of American Pigs.** — STANDARD POLAND-CHINA RECORD ASSOCIATION in *Freeman's Farmer*, Vol. LXX, No. 3, p. 15. North Yakima, Washington, March 1916.

The Poland-China breed originated in the Miami Valley, Butler County Ohio, at the beginning of the nineteenth century. Up to 1816 the Miami Valley contained two breeds of swine, the Russian or Russia and the Byfield. In 1815, the Society of Shakers introduced a boar and three brood sows known by the name of " Big China ", which were crossed with the Russians and the Byfields. The production of a breed called the " Warren County " pig, was the result. The name " Poland-China " was given to this breed at about 1860, although it had not been clearly shown that pigs of the Polish breed had entered into its formation.

The Poland-China is coarse, hardy, prolific and much larger than ie other ordinary breeds. It has a broad body, strong shoulders, short gs, head and shoulders well squared, pendulous ears, short head and es wide part. This breed is now considered the best, being the typical ne for the production of lard and obtaining the best prices in the market. he Western farmer is accustomed to graze his pigs in the summer and the oland-China is well adapted to this practice. It attains a very high eight, 880 to 1100 lbs for boars, 550 to 850 lbs. for sows or sometimes even nore. Its prolific character is indicated by the evidence of about 100 reeders, which shows that each litter contains on an average 9.75 young. itters of fifteen have been observed. Moreover the Poland-China is one f the most long-lived breeds; the case is cited of a sow living for eleven ears, during which time she had nineteen litters and a total of 189 descen- dants.

103 - **Ration Experiments with Swine.** — FAVILLE, A. D., in *University of Wyoming Agricultural Experiment Station, Bulletin* No. 107, pp. 15-27. Laramie, Wyoming, September 1915.

Pea Pasture (1) *for Fattening Pigs. Comparison of hurdled and non-hurdled Pasture.* — For this experiment there were employed twenty ie thrifty shoats divided into three groups of seven each group containing ith pure-bred and grade Duroc-Jerseys of which the latter were three urths Duroc and one fourth Tamworth. The supplementary ration was mixture of one part of grain middlings with two parts of corn meal. In ie course of the experiment, which lasted 112 days, each of the first two roups received 272 lbs of this ration and the third group 544 lbs. The eas for group I were hurdled off so that the pigs had access to fresh ines at short intervals. Group II was given the run of its entire field. ach of these two groups had at its disposal 1.47 acres of pasture. The hird group was not put on pasture. The results of the experiment are iven in Table I. They show that 365 lbs. or approximately 59 per cent ss grain was required for 1000 lbs. gain when pea pasture, hurdled, repla- d half the grain ration, and the saving was 313 lbs. or 51 per cent when

(1) See *B.* September 1916, No. 982.

the pasture was not hurdled. Comparison of the two groups proves that 52 lbs or approximately 17 per cent less grain was required for 100 lbs gain when the pea pasture was hurdled. One acre of hurdled pasture saved 1897 lbs. of grain, whilst one acre of the pasture not hurdled saved 1340 lbs. At the close of the pasture experiment Groups I and II were brought in and placed on a full grain ration, similar to the mixture they had been receiving, for 56 days. The results will be found in Table II. It will be seen at once that both pasture groups made considerably better gains than did Group III which had been fed on dry feed continuously. This more rapid development and the lesser consumption of grain for 100 lbs. gain should be credited to the residual effect of the pasture. Therefore taking the two experimental periods together, one acre of pasture, hurdled, saved 2086 lbs of grain, and one acre of pasture not hurdled saved 1568 lbs of grain, compared with an exclusivel ygrain feeding. Thus pea pasture is certainly a valuable aid in the production of cheap pork.

Comparison of the pure-bred and grade animals in the different groups shows that their gains of live weight were practically equal.

TABLE I. — *Pea Pasture, hurdled or not hurdled, for Pigs.*

Group	Average initial live weight	Average final live weight	Average daily gain	Grain consumed for 100 lbs. gain		
				Corn	Middlings	Total
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
I	65	174	0.97	167	83	250
II	67.3	157.3	0.80	201	101	302
III	68.4	156.9	0.79	410	205	615

TABLE II. — *Residual Effect of Pea Pasture for Fattening Pigs.*

Group	Average daily gain per pig.	Average daily grain per pig.	Grain for 100 lbs. gain
	lbs.	lbs.	lbs.
I	1.37	6.75	491
II	1.28	6.13	479
III	1.04	5.66	546

Alfalfa Tea for growing pigs. — A feeding experiment lasting 168 days was made on two groups of pigs, of four each. The grain ration consisted of equal parts of corn meal and middlings and of this mixture 3.3 lbs. were given per head per day both to the first group and to the second. For Group I this ration was mixed with water before feeding, whilst for Group II the

water was replaced by alfalfa tea, prepared by macerating 3 lbs. of alfalfa meal with 20 lbs of cold water allowing to stand from one feeding period to the next and then filtering through two thicknesses of cheese cloth. The tea had the following percentage composition, water 98, ash 0.56, crude protein 0.46, crude fibre 0.02, nitrogen-free extract 0.96, ether extract traces. The results given in Table III show that for 100 lbs. gain approximately 14 per cent less grain was required when alfalfa tea was used in the ration (Group II), but it is not certain that the employment of a small amount of alfalfa meal in place of the tea would not have proved equally advantageous.

TABLE III. — *Alfalfa tea for growing pigs.*

Group	Average initial live weight	Average final live weight	Average daily gain	Grain consumed for 100 lbs. gain		
				Corn	Middlings	Total
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
I	36.8	135.0	0.58	278.5	278.5	557
II	37.3	151.8	0.68	239	239	478

Comparison of corn meal and barley meal for fattening pigs. — At the close of the experiment with alfalfa tea the eight pigs used were divided into two groups in such a way that each of the new groups contained two of the animals from each of the old groups. The pigs of Group I had an average weight of 146.8 lbs, those of Goup II 140 lbs. For 56 days Group I was fed with a mixture of four parts of corn meal with one part of alfalfa meal, Group II with a mixture of four parts of barley meal and one part alfalfa meal. Both the increase of live weight and the weight of food consumed per 100 lbs. gain were practically equal in the two groups, and the conclusion was drawn that barley-meal was as satisfactory a pig feed as corn meal.

Comparison of pea hay and alfalfa hay for brood sows — Two groups, each containing three brood sows were fed for 91 days with a mixture of two parts of corn meal and one part of middlings (3.6 lbs per head per day). In addition Group I was given 1.9 lbs of alfalfa hay, and Group II, 1.9 lbs. of pea hay per day. The results given in Table IV show alfalfa hay was somewhat the better.

TABLE IV. — *Comparison of pea hay and alfalfa hay for brood sows.*

Group	Average initial live weight	Average final live weight	Average daily gain
	lbs.	lbs.	lbs.
I	254	303	0.54
II	270	309	0.43

Value of alfalfa hay in fattening rations for broods sows. — Of the five animals available for the work, Group I containing two, received corn meal, Group II, containing three, was given a ration composed of four parts of corn meal and one part of alfalfa meal. The experiment lasted 42 days. The two groups fattened rapidly, Group I gaining 2.9 lbs. per head per day, Group II 2.1 lbs per head per day. The first group consumed 410 lbs. of corn meal, the second 389 lbs. corn meal and 97 lbs. of alfalfa hay per 100 lbs. gain.

1104 – **The Fattening of Pigs on Pasture under Forest.** — RAUSER, in *Mitteilungen der Vereinigung deutscher Schweinezüchter*, 23rd year, No. 16, pp. 185-187. Berlin, August 15, 1916.

In order to ascertain whether in time of shortage of food, pigs could be economically fattened in the forest, 30 hardy animals having a long snout and a good frame, which were accustomed to grazing, were purchased for this purpose. The forest was gratuitously put at the disposal of the writer by the commune of Rodenbach.

The total weight of the 39 pigs before grazing was 2 056 lbs. or 52.6 lbs per head. The total purchase price was 2 541 marks, from which the price per pound of live weight is calculated to be 1.23 marks. The pigs are described as being of excellent quality.

The animals were put on pasture in three separate lots: 17 on September 4, 2 on September 9, and 20 on September 19. The forest is composed chiefly of oaks and beech-trees and has an area of 111 acres. During the night the pigs were brought back into a common stable of the village. Every morning and evening each pig was given some pounds of a supplementary food composed of molasses, bran, cocoa-cake, maize and potatoes, 55.6 cwt. being administered altogether, but the principal forage was furnished by the forest. The trees and game suffered no damage from the pigs. The latter were taken off the pasture, some in October, some in November and the remainder in December. One had died 17 days after being put on pasture, and three, on account of their abnormal developement, had to be slaughtered before the end of the experiment. Altogether the animals spent 3 189 days in the forest, or 81 days per pig. In this period the total increase in weight was 1 785.5 lbs. that is scarcely 8.8 oz. per day, the four pigs eliminated being included in the calculation. On the other hand with some animals increase amounted to 8.8 to 13.2 oz.

The financial result of the experiment was as follows:

Cost of the 39 pigs	2 541 *marks*
Concentrated food and cost of feeding	1 426
Rent of stable, repairs of fences	20
Wages of swineherd	17
Cost of transport	21
	4 055 *marks*
Receipts.	
Sale price of 38 pigs	4 036 *marks*
Loss	19 *marks*

If all the animals had survived until the end of the experiment there would have been a profit instead of a loss. It should also be mentioned that the excessively high price of maize had a considerable effect on the result Although the latter was negative in this case, the writer believes that this method of fattening would be remunerative in Germany, since by it otherwise useless products of the forest can be transformed into valuable pork. The experiment is to be repeated in other communes.

1105 - **British Berkshire Society's Report.** — *Farmer & Stock Breeder*, Vol. XXIX, No. 1406, p. 1433. London, Sept. 4, 1916.

The British Berkshire Society (1) has issued its annual report consisting of a record of the main activities of the breed during the past year. A table of export certificates issued for the past 10 years shows that 2181 certificates have been given, 999 of which were for pigs exported to the Argentine. The United States comes next in the list with 147, Canada third with 136, Russia fourth with 129, and Brazil fifth with 127. It is remarked, as indicating the weights to which the breed will grow, that Berkshire sows at six months, in ordinary growing condition and given proper exercise, weigh from 150 to 160 lb, and boars from 160 to 170 lb. At one year sows in breeding condition weigh from 400 to 500 lb. and when full grown from 550 to 650 lb. Boars one year old in show condition have been known to weigh 600 lb. The success of the breed at Smithfield is discussed where no other breed has had such a long run of successes in the carcass classes.

1106 - **A Study of Constitutional Vigour in Poultry.** — Rice, J. E. *Cornell University Agricultural Experiment Station, Department of Poultry Husbandry, Bulletin* No. 315, pp. 439-357. Ithaca, N. Y., 1914.

In the autumn of 1909 two experimental flocks of White Leghorn hens were formed. For the one all the largest hens were selected and it was called the strong flock, for the other, or weak flock, the smaller hens were chosen. During the next two years all the progeny were also divided up into strong and weak flocks. Both kinds of fowls were kept under identical conditions and received the usual Cornell rations for laying hens, *e.* a dry grain mixture made up of :

in winter :				in summer :			
60	lbs.	of	wheat	60	lbs.	of	wheat
60	"	"	maize	60	"	"	maize
30	"	"	oats	60	"	"	oats
30	"	"	buckwheat				

fed morning and afternoon in straw litter ; and in the afternoon only, a mash consisting of :

60	lbs.	of	maize	meal
60	"	"	wheat	middlings
30	"	"	wheat	bran
10	"	"	alfalfa	meal
50	"	"	beef	scrap
1	"	"	salt	

(1) E. Humfrey, Shippon, Abingdon, Berks. Secretary.

TABLE I. — *Average food consumption per hen per annum.*

	Strong flocks	Weak flocks
	lbs.	lbs.
Total quantity of food	80.30	75.91
Total quantity of food including grit and shell	77.07	72.82
Total quantity of food including grit, shell, and green food	67.49	62.73
Total whole and ground grain	60.16	56.58
Total whole grain	44.46	44.05
Ground grain	15.70	12.53
Meat scrap	4.82	3.95
Grit and shell	3.23	3.09
Green food	9.58	10.09
	per cent	per cent
Whole grain in total food including grit, shell, and green food	65, 9	70,2
Ground grain in total food including grit, shell and green food	23.3	20,0
Meat scrap in total food excluding grit, shell and green food	7.1	6,3
Grit and shell in total food including green food	4.6	4,7

TABLE II. — *Food nutrients consumed per hen per annum.*

	Strong flocks	Weak flocks
	lbs.	lbs.
Dry matter	61.73	56.93
Protein	9.69	8.50
Carbohydrates	39.50	37.72
Fat	2.59	2.41
Ash, including grit and shell	1.91	1.73
Albuminoid ratio	1 : 4.68	1 : 5.08

The records for the two original flocks and all their proge (amounting to 76 strong and 75 weak flocks) have been summarised f the three years 1909-1911 (Tables I to V). The strong fowls consum more food than did the weak fowls. Both had the same amount of grai but the strong fowls were able to consume more meal and meat scra Consumption of grit and shell were practically equal in the two groups. Th

TABLE III. — *Consumption per unit live weight and per dozen eggs produced.*

	Strong flocks	Weak flocks
Dry matter consumed per pound of live weight, in lbs.	17.68	17.68
Food consumed per dozen eggs laid, in lbs.	7.68	8.46
Cost of food per dozen eggs laid.	$0.114	$0.123
Total number of eggs produced per hen	125.36	107.61

TABLE IV. — *Hatching and mortality records.*

		Strong flocks	Weak flocks
Number of eggs set		1,446	1,305
Percentage of fertile eggs		89.4	91.4
Percentage of eggs hatched in fertile eggs		55.4	56.4
Percentage of eggs hatched in number set		49.6	51.5
Average weight of eggs set in pounds		0.2081	0.2198
Average weight of chicks hatched in lbs		0.09096	0.0767
Percentage mortality of chicks to six weeks of age		23.15	19.64
Flock mortality	Total number of hens	108	104
	Total number of deaths	12	12
	Percentage mortality	11.1	12.5

TABLE V. — *Average receipts and expenses per hen per annum.*

	Strong flocks	Weak flocks
Receipts:	$	$
Value of eggs	3.12	2.67
Value of gain in live weight	0.07	0.06
Total	3.19	2.73
Expenses:		
Cost of food	1.19	1.10
Cost of loss of stock	0.08	0.11
Total	1.27	1.21
Balance profit	1.92	1.52

number of lbs. of dry matter eaten per lb. of live weight averages the same for both strong and weak birds (Table III), but whereas the strong fowls required only 7.68 lbs. of food for every dozen eggs laid, the weaker flocks required 8.46 lbs. After the first period of the experiment, egg production was consistently heavier in the strong flocks, the difference amounting to 17.75 eggs per hen per annum and being sufficient to justify the selection of stronger pullets for egg production.

1107 – **Rations for Growing and Fattening Roasters and Capons.** — Buss, W. J., *Ohio Agricultural Experiment Station, Bulletin* No. 284, pp. 155-172. Wooster, Ohio, 1916.

Experiment 1. — The object of this experiment was to compare the relative efficiency and economy of the different rations for the production of roasters and capons, and to determine the amount of feed required to produce one pound of live weight increase. The chickens used were 139 pure and 56 cross-bred Barred Plymouth Rocks, the crossbreds being the offspring of Light Brahma and Leghorn crosses. Of these 195 birds 94 were cockerels, all except 8 of which were caponised when 4 months old. At the start the chicks were only two months old and they were kept under experiment for 32 weeks.

The five rations in question are given below.

Ration	Grain	Mash
I	maize	2 parts ground maize. 1 " beef scrap.
II	maize	1 " ground maize 2 " beef scrap. The amount of maize was increased one part each week so that by the 32nd. week, the mash consisted of: 32 parts ground maize. 2 " beef scrap.
III	11 parts maize 15 " wheat 4 " oats	2 " ground maize. 2 " bran. 1 " beef scrap.
IV	maize	7 " ground maize. 3 " tankage.
V	maize	3 " ground maize. 4 " oilmeal. Ration fed for 12 weeks by which time the chicks were doing so badly that they had to be put on Ration I.

In addition all birds had access to grit, charcoal and an abundant supply of water. The mash was kept in hoppers to which the fowls had access at all times.

Experiment 2. — The feeding trials were repeated with 125 purebred Plymouth Rock capons, using exactly the same rations as before, except in the case of the fifth group where the birds were fed on ration I, but were confined to small pens instead of being allowed to range. Four to four and a half months old birds were chosen and the experiment lasted 19 weeks.

The adjoining Table summarises the results of the two experiments. aking the average of both trials, ration I produced a slightly higher rate gain than did the others. Ration II which contained a constantly de-easing amount of protein lowered the rate of gain and raised the food con-umption. The bird, fed on ration III consumed the most food per bird d per pound of live weight increase ; the cost of the food for this group as about 30 per cent higher than that for the others. Capons confined small pens, while consuming only 2 per cent less feed per bird, gained bout 17 per cent less than capons allowed to range, and the cost of their od was consequently 17 per cent higher. Prices of foods used in the alculations were as follows :

	Price per cwt.		Price per cwt.
	$		$
Shelled maize	1.00	Beef scrap	2.75
Ground "	1.09	Tankage	2.40
Wheat	1.50	Oil meal	1.80
Bran	1.40	Grit	0.75
Oats	1.25	Charcoal	2.25

In the first experiment where pullets, cockerels and capons were fed ogether, capons invariably made the most rapid gains, the average total ve weight increase being for capons 6.8 lbs., for cockerels 6.1 lbs. and for ullets 4.6 lbs.

Comparative efficiency of rations for fattening roasters and capons.

Average total gain per bird			Average total consumption per bird			Food consumed per lb. of live weight increase			Cost of food per lb. of live weight increase		
Experiment		Mean	Experiment		Mean	Experiment		Mean	Experiment		Mean
1	2		1	2		1	2		1	2	
lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	cents.	cents.	cents.
6,3	4,6	5,55	47,2	37,7	42,4	7,3	8,1	7,7	9,1	10,1	9,6
6,4	4,5	5,45	49,2	38,8	43,5	7,7	8,6	8,1	8,7	10,3	9,5
6,6	4,4	5,50	55,8	41,3	48,5	8,5	9,2	8,8	11,7	13,2	12,4
5,9	4,6	5,25	45,5	37,6	41,5	7,7	8,2	7,9	9,1	9,8	9,4
5,8	3,8	4,80	43,5	36,2	39,8	7,5	9,5	8,5	9,3	11,9	10,6

Results expressed as a percentage of those fed on ration I.

100	100	100	100	100	100	100	100	100	100	100	100
99	97,1	98,2	104,3	103	104,8	105,3	106,1	105,1	95,4	107,6	97
102	96,7	99,5	118	109,6	115,4	115,4	113,8	114,5	128,3	130,5	128,7
91,6	99,2	94,5	96,4	99,8	98,1	104,8	100,6	103,2	100,1	96,8	98,8
—	82,4	—	—	96,1	—	—	117,1	—	—	117,5	—

FISH CULTURE.

1108 - **Investigations on the Number of Eggs Produced by Certain Fish.** — MART, in *Allgemeine Fischerei-Zeitung*, Year XLI. No. 16, pp. 255-260. Munich, August, 15, 19

Very little is known with regard to the exact number of eggs produc by various species of fish ; hitherto only rough estimates have been ma or where experiments have been carried out, the females have not been the same age. At the Bavarian trout hatchery (Starnberg), 58 common tro (*Trutta fario*) and 54 rainbow trout (*Trutta iridea*) were stripped and t ova were carefully counted with results given in Tables I and II.

It would appear that the heavier, *i. e.* the older, the fish the great the number of eggs produced ; but if the results are considered from t point of view of production per unit weight, the young fish yield a relativ ly larger number of eggs, though the eggs are not so heavy. In oth words with a given quantity of matter young fish form a larger number eggs than do older fish.

As these results could be questioned on the grounds that some of t fish might have been incompletely stripped or that the fish might ha

TABLE I. — *Number of eggs produced by common trout*

Weight of fish					No. of eggs per fish	Weight of eggs per 100 parts live weight	Weight 1000 eggs	No. of e per unit w of live we (1 kilog
lbs.	oz.		lbs.	oz.			oz.	
	7	—		8.5	707	23,6	2.7	2 99
	8.5	—		10.5	751	22,0	2.9	2 64
	10.5	—		14	879	20,4	3.1	2 59
	14	—	1	5	1 090	21,0	3.4	2 17
1	5	—	2	11	1 293	19,3	3,7	1 82
over			2	11	3 017	19,1	3.6	1 83

TABLE II. -- *Number of eggs produced by rainbow trout.*

Weight of fish					No. of eggs per fish	Weight of eggs per 100 parts live weight	Weight of 1000 eggs	No. of eg per unit we of live wei (1 kilog)
lbs.	oz.		lbs.	oz.			oz.	
	8.5	—		10.5	945	18,0	1.7	3 577
	10.5	—		14	1 154	16.6	1.6	3 323
	14	—	1	5	1 547	17.4	2.0	3 063
1	5	—	2	11	1 975	16,1	2.4	2 33
over			2	11	2 798	15.8	3.0	1 82

TABLE III. — *Number of eggs produced by perch.*

Length of body	Weight of body	Weight of eggs	No. of eggs per fish	Weight of eggs per 100 parts live weight	No. of eggs per unit weight live weight (1 kilog.)
in.	oz.	gms. (1)			
10.2	8.7	31.00	30 480	12.4	121 000
9.3	6.9	23.20	26 390	12.0	129 000
8.5	6.5	34.50	24 980	18.0	133 000
9.3	6.0	27.60	23 749	16.2	139 000
7.3	3.7	14.00	14 700	13.1	137 000
7.1	2.4	10.40	11 160	15.0	159 000
7.1	2.3	9.94	9 480	15.4	146 000
5.9	1.4	6.65	6 120	17.0	157 000
5.4	0.9	3.97	4 190	15.3	160 000
5.2	0.9	5.10	4 810	20.0	188 000
5.1	0.8	5.05	4 060	22.5	184 000
5.0	0.7	4.46	4 320	22.0	203 000
4.0	0.4	3.14	3 710	18.5	218 000
Mean 6.9	3.8	13.77	12 934	16.7	159 538

(1) 1 gm. = 0.035 oz. = 0.56 drachms.

TABLE IV. — *Number of eggs produced by roach, ruffe, and Chondrostoma nasus.*

	Length of body	Weight of body	Weight of eggs	No. of eggs per fish	Weight of eggs per 100 parts live weight	No. of eggs per unit weight of live weight (1 kilog.)
	in.	oz.	gms.			
Roach	9.8	8.3	37	66 250	15.5	275 000
Chondrostoma nasus .	14.4	23.6	97.75	32 250	13.4	44 500
Ruffe.	5.9	13	4.71	4 705	12.7	370 000

begun to spawn before they were captured, the experiments were repeated using perch (*Perca fluviatilis*). Females just about to spawn were killed and weighed. Their ovaries were removed, part of each was dissected, the ova were counted and accurately weighed. The weight of the whole ovary was likewise determined and from this, the number of eggs in each fish was calculated. The results are given in Table III and confirm those obtained in the previous experiments.

A few relevant figures for roach (*Leuciscus rutilus*) for *Chondrostoma nasus*, and for the ruffe (*Acerina cernua*) are appended in Table IV.

1109 - **The Improvement of Carp and Pikeperch Fisheries in Lake Balaton, Hungary**(1). — REPASSY, M. in *Halaszat* (Fishing), Year XVII, No. 10, pp. 93-99. Budapest, May 15, 1916.

In 1915, the company which holds the fishing rights of Lake Balaton adopted a new scheme for restocking the lake. It was decided to propagate the more valuable kinds of fish and more especially carp and pikeperch, the latter being the species of the greatest economic importance. The close season was fixed for the whole of the month of April. During that period artificial spawning beds are to be laid down in places frequented by pike perch, and when spawning is finished the ova are to be collected and placed in baskets close in to the shore and where the water is fairly still. Five hundred spawning beds are to be used and it is expected that the eggs collected will amount to at least 50 millions. Every autumn 10 tons of selected fry will be set free in the lake. This will consist either of one year old pikeperch averaging 2 3/4 to 3 1/2 ozs. or two year old carp weighing from 3/4 to 1 1/2 oz.

Ever since the fishing was brought under revised management in 1900 careful records have been kept of the amounts of the different species taken from the lake. The figures from 1900-1915 are given in Table I. The total amount of fish landed varies considerably from year to year. Daily catches even are extremely irregular, in one instance there is a record of as much as 30 tons being taken in one day in the Siolfolk fishing ground alone. To eliminate these variations as much as possible the figures have been collected into two 6 year periods in Table II.

Treated in this way the records show that there has been a perceptible change in the proportion which valuable species bear to inferior ones, resulting in a small increase of the former. With regard to the total production, there has been little variation between the two periods, the annual produce being 15.7 lbs. in the first period and 15.5 lbs. during the second period per cadastral arpent. These figures are low compared to yields obtained in artificial lakes, and bearing in mind the limits of the food supply in natural waters it would appear that they are not susceptible to much increase. The improvement of the fishery will rather be in the direction of developing the valuable species at the expense of the inferior ones which are still six times more numerous than carp and pikeperch. During the second six years period the slight change in ratio between the valuable and inferior kinds (about 10 per cent) made a difference in the returns of over £ 700 per annum ; and if it were possible to replace another 100 tons of bream and shad by 100 tons of carp the annual value of the fish landed might be increased by about £ 3000.

In the years 1901, 1906 and 1909 carp fry were set free in Lake Balaton and it may be seen from Table I. that these attempts at stocking the lake had a distinct effect on the catches of the following seasons.

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(1) See *B.* Feb. 1916, pp. 180-187 : *Fishing and Fish Culture in Hungary.* Original article.

J. DE LANDGRAF.

Amounts of the different kinds of fish taken in Lake Balaton, 1900-1915 (*long tons*).

Year	Inferior kinds			Valuable kinds				Total production	Ratio: inferior kinds to valuable kinds	Remarks
	Bream	Thwaite Shad (*Alosa Finta*)	*Aspius rapax*	Pikeperch	Carp	Sheat fish *Silurus glanis*	Pike and tench			
1900–1901	450	327	15	80	4	7	29	912	6,7 : 1	
1901–1902	283	131	6	92	4	2	21	540	3,5 : 1	Fishing under ice.
1902–1903	494	90	11	91	10	6	31	734	4,3 : 1	
1903–1904	498	314	11	58	9	5	16	911	9,4 : 1	
1904–1905	622	178	8	84	7	4	14	917	9,9 : 1	
1905–1906	353	151	8	74	7	5	12	610	5,2 : 1	
1906–1907	502	68	8	100	7	5	21	772	4,8 : 1	
1907–1908	472	176	9	78	7	5	29	776	5,5 : 1	
1908–1909	534	131	15	92	14	6	15	806	5,4 : 1	
1909–1910	514	112	13	93	18	5	7	763	4,2 : 1	
1910–1911	558	97	8	72	8	5	14	762	6,7 : 1	
1911–1912	414	160	9	82	8	6	23	702	4,9 : 1	
1912–1913	398	212	11	71	11	7	13	725	6,0 : 1	
1913–1914	292	59	13	63	7	6	9	448	4,3 : 1	Scarcity of labour.
1914–1915	322	73	3	38	3	2	8	451	7,5 : 1	

TABLE II.

Comparative yields of fish from Lake Balaton in two 6 year periods, 1900-1906 and 1900-1912 (long tons),

Year	Inferior kinds			Valuable kinds				Total production	Ratio: inferior kinds to valuable kinds
	Bream	Bleak (*Alosa Finta*)	*Aspius rapax*	Pikeperch	Carp	*Silurus glanis*	Pike and tench		
				Total amounts.					
1900–1906	27 01	11 91	59	4 79	41	30	1 23	46 23	5,7 : 1
1906–1912	30 54	7 43	62	5 18	61	33	1 08	45 80	5,2 : 1
Difference.	+ 3 53	— 4 48	+ 3	+ 39	+ 20	+ 3	— 15	— 43	
				Mean annual yield.					
1900–1906	4 50	1 98	9,8	80	7	5,0	20	7 70	
1906–1912	5 09	1 24	10,4	86	10	5,5	18	7 63	
Difference.	+ 59	— 74	+ 0,6	+ 6	+ 3	+ 0,5	— 2	— 7	
Difference per cent . . .	+ 13 %	— 38 %	+ 6 %	+ 8 %	+ 49 %	+ 10 %	+ 12 %	— 1 %	

FARM ENGINEERING.

o - **Machinery Cost of Farm Operations in Western New York.** — MOWRY, H. H. in *Bulletin* No. 338. *United States Department of Agriculture.* Washington, D. C., January 18, 1916.

The aim of the writer (Assistant Agriculturist, Office of Farm Mananentj is to determine what is, under normal conditions, the average ser- e given by agricultural implements generally in use in seven different inties in New York State: Niagara, Orleans, Monroe, Wayne, Genesee ingston and Ontario. In response to an enquiry addressed to several usands of farmers, reports were received on some thousands of machines 19 different kinds: 1 165 walking ploughs, 294 sulley ploughs, 1 169 ing-tooth harrows, 824 spike-tooth harrows, 738 disc harrows 1 173 land ers, 1 061 grain drills, 72 one-row corn planters, 97 two-row corn plan- s, 1 114 one horse cultivators, 881 riding cultivators, 217 cabbage trans- nters, 359 engine sprayers, 1 232 mowers, 1 217 hay rakes, 416 hay ders, 563 bean harvesters, 1 028 grain binders, and 458 corn binders.

Method of Computing Replacement Costs. — The replacement charge per r, per acre, or per day is based on the proportional use and not on the sale e of the machine at any time during its life. For the farmer who ex- ts to remain in business for a period exceeding the life of the machine, this he logical method to use.

The tables of which we give an extract, will be found useful in esti- ing the machinery cost of work and the fair charge against work already e. They will also assist the man expecting to give up farming and sell machinery, or wishing to buy secondhand implements. Both buyer seller will then have a fair means of arriving at a fair value in their nsactions.

Method of Computing the Interest Charge (1). — Where a part of the cost of equipment is charged off annually to provide for its replacement, average investment upon which interest must be allowed is shown in table below:

Method of Determining the Service of Farm Machinery. — The writer de- es the method used to obtain his results: it is based on the average fi- s for each type of implement in New York State.

The service expressed in acres was obtained by multiplying the service ears by the average work done annually. The work in days was found

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1) The average investment in equipment, where a fraction of its first cost is charged ch year for replacement, may be found by the rule:

$$\text{Average investment} = \text{first cost} \times \frac{\text{years of service} + 1}{\text{years of service} \times 2}$$

y multiplying the average investment by the prevailing rate of interest in the locality the equipment is located the annual interest charge against the equipment is found.

Technical Data Relating to the Different Machines.

Kind of machine	Average area covered annually — Acres	Average length of service rendered — Years	Average area covered during life — Acres	Average cost when new — $	Average cost of repairs during life — $	Total interest during life at 6 % — $	Total cost of machine during life — $	Remarks
Cultivating machines:								
One-horse cultivator	16.9	14	236.6	6.50	4.90	2.94	14.34	Most economical on larger areas.
Riding cultivator	39.3	12.5	491.3	32.00	12.38	13.00	57.38	The overhead charges are more than twice those for the one-horse machine.
Walking plough	32.9	11.7	384.9	10.00	23.99	3.86	37.85	Very strong; repairs expensive; price low.
Sulky plough	30.9	8.1	250.3	42.50	17.17	11.58	71.25	Heavy wear on working parts.
Spike-tooth harrow	48.3	14	676.2	10.50	4.76	4.76	20.02	Use not general; life 1/4 longer than the following machine.
Spring-tooth harrow	71.1	11	782.1	17.50	8.25	5.83	31.58	Gives long service.
Disc harrow	35.2	13	457.6	27.00	6.50	11.31	44.81	The larger model costs 1/4 more than the small.
Land roller	65.9	16	1 054.4	24.00	7.52	11.20	42.72	Low interest charge.
Grain drill	46.3	16.4	759.3	72.00	20.66	37.56	130 22	Substantially built.
Corn planter (2-row)	8.3	11	91.3	40.00	18.48	12.41	70.89	Repairs comparatively expensive.
Cabbage transplanter	12.5	12.8	160.0	45.00	14.46	18.56	78.02	Most economical on large areas.
Harvesting machines:								
Hay tedder	21.6	14	302.4	34.00	5.74	15.26	55.00	Suitable for large areas.
Hay rake	43	14.5	623.5	24.00	5.22	11.17	40.39	Repairs low.
Mower	28	14.8	414.4	41.00	26.94	19.39	87.33	Average farmer does not obtain maximum work from machine.
Grain binder	35.2	15.4	542.1	125.00	31.20	61.60	218.02	Small models last longer but do less work.
Corn binder	21.2	10.8	227.9	125.00	21.92	43.28	190.20	Repairs expensive.
Bean harvester	16.9	12.9	218.9	25.00	13.03	10.32	48 35	Long life.

Fraction of cost new charged off annually	Average investment (per cent of first cost)	Fraction of cost new charged off annually	Average investment (per cent of first cost)	Fraction of cost new charged off annually	Average investment (per cent of first cost)
	%		%		%
ll.	100.00	One-eighth . . .	56.25	One-fifteenth . .	53.33
ne-half	75.00	One-ninth . . .	55.55	One-sixteenth. .	53.12
ne-third	66.66	One-tenth . . .	55.00	One-seventeenth.	52.93
ne-fourth . . .	62.50	One-eleventh . .	54.54	One-eighteenth .	52.77
ne-fifth	60.00	One-twelfth . .	54.17	One-nineteenth .	52.63
ne-sixth	58.33	One-thirteenth .	53.84	One-twentieth. .	52.50
ne-seventh. . .	57.14	One-fourteenth .	53.57		

y dividing the service in acres by the normal acreage or day's work done by
e machines.

Cost of Repairs. — Where ordinary care is used by the operator, the pair charges should make up but a small proportion of the total cost.

Relation of Annual Repairs to First Cost. — The writer gives the type of plement, the annual cost for repairs calculated as per centage of the first st, and the average present value of the equipment. The percentage ried from 1.2 to 5.8 except for the walking plough for which the per- ntage was over 20.5.

Shelter. — There are no data available on the relative life of machinery ien housed and when not housed. Farmers allow 20 per cent of the first st of the machine in cases where special shelter is necessary.

Relation of Machinery Cost to Total Cost of Farm Operations. — The writer es account of man-time and horse-time. One man is able to manage all implements except the cabbage transplanter which requires three men. e machine cost of the different operations does not exceed 50 per cent of whole: ranging from 4.7 per cent for the walking plough to 42.8 per cent the grain binder.

Conclusion. — The data collected by the writer should help agricul- ists to determine the probable length of service for the various imple- nts, the normal cost of repairs, and, allowing for the size of their hold- s, to decide whether to buy or hire farm machinery.

- **Maillet Motor Cultivator with Controlled Rotary Blades.** — FREMIEL, VICTOR, in *Le Génie rural*, 8th year, No. 62, New Series, No. 2 of 1916, pp. 9-14, Paris, July, 1916.

This invention is a distinct advance on the 2 or 3 speed motors of the al American pattern. In practice the 2 or 3 speeds are unsatisfactory often difficult to operate. whether by shifting the blades on their axle y changing the speed of rotation ; this latter method leads to objection- complication in the gear-box. In order to avoid these difficulties the entor has combined the speed of rotation with the travelling speed. has designed a ploughing mechanism, illustrated in Fig. 2, which consists

essentially of an axle carrying a spiral blade. This does the work of a seri of little ploughs with the working parts: coulter, share and mould-boar This mechanism is caused to rotate by the same motor which moves th whole machine forward along the line of work.

As the machine moves forward, the soil along the whole length of th spiral blade is successively lifted and turned by the appropriate combine action of the rotating and travelling gears. To provide the range of speed desired, the designer has fitted two sets of gearing operated by levers o pedals. The speed of rotation is so controlled relative to the travelling spee

MAILLET *Cultivator.*

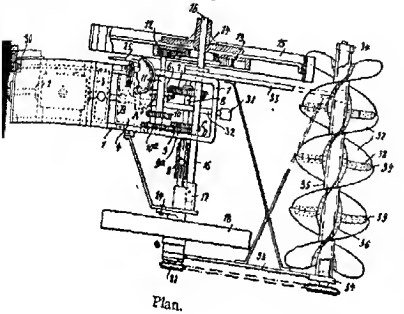
Fig. 1. — General view.

that any cut may be taken from a mere shaving to a large swathe, i.e the soil is finely or coarsely cultivated.

The motor and clutch are enclosed in a case 4 (fig. 2) which contain the gears A and B giving the two speeds to the shaft 5, thence to the be vel-pinion 6 and bevel-wheel 7 keyed on the transverse shaft 8. On thi shaft two pinions C and D engage with the wheels 10 and 10 a; this allow the speed of shaft 11 to be varied according to which pair of wheels are in gear.

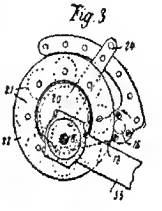
In gear	Forward movement	Blades
A and *C*	32.8 yards	90 turns
A " *D*	43.7 "	90 "
B " *C*	44.8 "	130 "
B " *D*	60.1 "	130 "

Fig. 2.



Plan.

Fig. 3



Clutch.

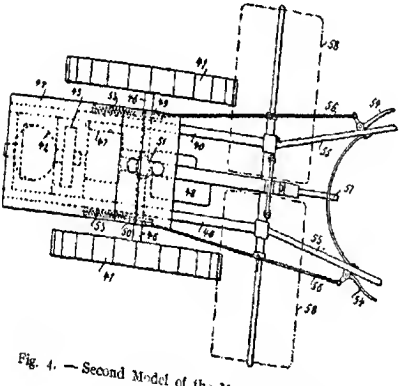
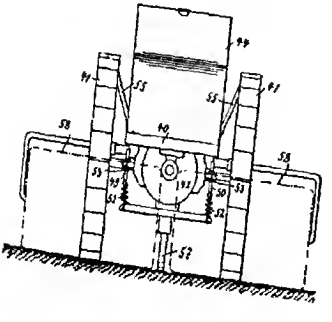


Fig. 4. — Second Model of the MAILLET cultivator, Plan.



The end of shaft 8 carries the sprocket 27 which drives the cultivator by a chain. The axle of the cultivator is cast with flanges 36 to which the spiral blades 37 are attached.

The other end of shaft 11 carries a pinion 12 which turns the driving wheel 15 through a gear 13 mounted on the hub 14.

As shown in fig. 2, the hub 14 of the driving wheel is carried far out on the axle 16 so that the load in the latter is as close as possible to the centre of gravity of the wheel. The track of the machine can be altered by moving the sleeve 17 along the axle 16 to which it can be fixed by bolts.

To keep the machine level when at work, the lever 24 (fig. 3) is used this is connected to a centre-piece 20 controlled by a hand lever.

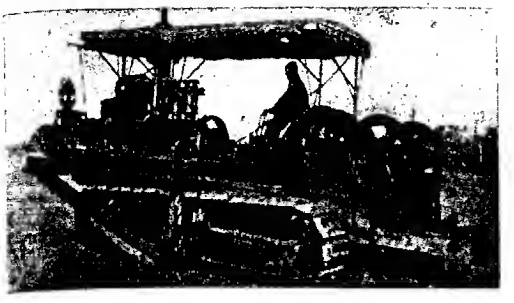
In another model, illustrated in fig. 4, the machine consists of a frame 40 carried by two wheels 41 which serve both for driving and steering the motor 42 and clutch 43 are covered by a bonnet 44. A first gear-box 47 controls both the travelling speed and that of the implement; a second gear-box 48 acts independently on the travelling speed. This machine like that described above, provides two changes of speed; to keep the axle parallel with the plan of the machine on level ground, the hand control 54 acts on the verticle springs 52 (fig. 5); on uneven country they allow the wheels to adapt themselves to the irregularities of the ground without altering the position of the machine laterally. Two other springs 53 act horizontally and keep the track parallel to the frame. The machine is steered by controlling these springs. A shoe 57 regulates the working depth and keeps the direction. In working ridges this shoe is furnished with a cutter.

The cultivator 58, situated in the rear, is made in two portions, one with a right and the other with a left-handed spiral, allowing for earthing up or splitting the ridges. The machine can be used for all kinds of farm work; it will draw a plough or drive thrashing or other machines.

There is a special model for vineyard work; the constructional details are similar to those reproduced in figs. 4 and 5.

1112 – **Petrol Tractor for Drain Digging.** — PERKINS, FRANK, in *Engineering Record*, Vol. N° 5, p. 134. New York, July 29, 1916.

Weight 15 tons; motor 60 H. P.; 2 caterpillars 30 in. wide allow the machine to operate on soft land where teams could not well be used. The tractor carries a drum 16 in. diameter by 24 in. long which can roll 1000 of $^3/_4$ in. cable; paying-out speed: 10 to 14 ft. per minute. Mode of operation: the plough, which can dig a drain 2 feet wide and 3.5 feet deep, attached to the tractor by the cable, the drum being- de-clutched, the tractor moves forward to the finishing point. The drum clutch is then let and the cable wound up taut; the tractor is kept stationary by two anchors situated in front. The cable is wound in until the plough reaches the end of the drain. When it is desired to move forward the anchors are lifted. Travelling speed: 2 miles per hour.



Petrol tractor for drain digging.

13 - **Simple Steam Sterilizer for Farm Dairy Utensils.** — AYERS, HENRY, and TAYLOR, G. R., in *Farmers' Bulletin* 748. Washington, D. C., July 22, 1916.

The sterilizer consists of a roasting-pan A which, with its insulated ver B, forms the bottom of the box C, and is heated by a two-burner oil ove. (fig. 1).

The cover is made of galvanised iron ; the lower part is covered with sbestos and overlaps the ends of the plan. Instead of asbestos, paper com-

Sterilizer for dairy utensils.

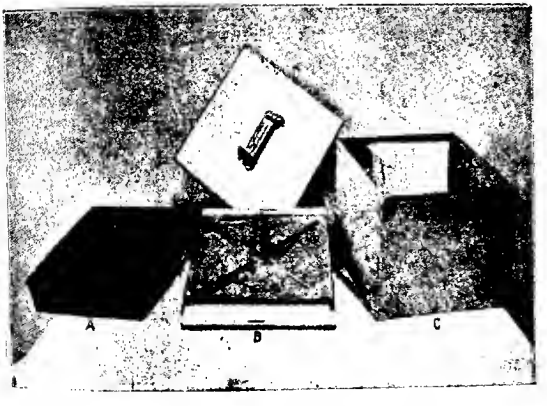


Fig. 1. — Parts for the sterilizer.

etely enclosed in sheet iron may be used. A hole 1 ½ inches in diame- is made in the centre of the cover and a pipe soldered to it 4 ½ inches in

height. The diagonal strips on the cover B act as supports for the cans or other utensils to be sterilised.

Method of Operation : Fill the roasting pan with water to the depth of 1 inch. Heat until the steam coming from the end of the outlet pipe reaches a temperature of 205° F. Place the can to be sterilised, preferably enclosed in an insulating cover, upside down over the outlet and leave for

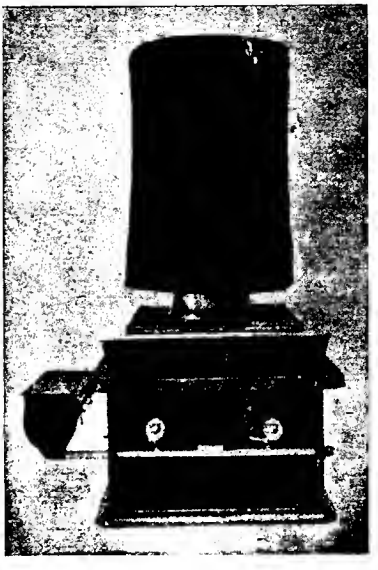


Fig. 2. — The sterilizer in action.

5 minutes, (fig. 2) then remove and place upright on the floor. The can should be absolutely dry in one or two minutes if the temperature has reached 205° F.

Cost of Operation : The two burners use one pint of paraffin per hour. Taking oil at 10 cents a gallon, the cost of sterilising three cans, with covers and strainers, is about 1 cent for 35 minutes operation. One inch of water in the roasting pan will furnish steam at 211° F. for about 50 minutes.

RURAL ECONOMICS.

1114 - **Farm Management Practice of Chester County Pa., U. S. A.** — SPILLMAN, W., DIXON, H. M. and BILLINGS, G. A., in *United States Department of Agriculture Bulletin* N° 341, (Professional Paper), pp. 1-99. Washington, January, 17, 1916.

This report from the Office of Farm Management, United States Department of Agriculture, based on the analytical study of 643 farms in Ches

ter County, Pa, is designed to work out a method of studying farm management in a particular district, to discover fundamental principles of farm management and to work out their application to the agriculture of the district.

The more important of the fundamental principles of farm management brought out clearly in this study, and amply confirming similar studies, are:

The type of farming followed in any given case must be adapted to local soil, climatic and labor conditions, and especially to local conditions with reference to markets and market facilities, as well as to the business conditions existing on the individual farm.

When the conditions affecting the agriculture of a region have remained stable for a considerable period local agricultural practice tends to become approximately what it should be for the best results, provided the practice which gives the best immediate returns does not unfavorably affect soil fertility. When conditions change, even slightly, if the change is permanent, local farm practice begins to change and ultimately adapts itself to the new conditions.

Success in farming, measured in terms of the family income and standard of living, is directly proportioned to the magnitude of the farm business. With the types of farming generally adapted to this locality many of the farms found in this survey are too small to permit a satisfactory standard of living.

In the matter of yield of crops per acre, the point of dimishing returns is reached on a considerable proportion of farms. Profits increase as yields increase until the yields are considerably above the average for the locality, but beyond this, increased yields are obtained at the expense of farm profits.

In quantity of product per dairy cow, the point of diminishing returns is not reached in ordinary farm practice. Hence, on dairy farms, quantity of product per cow is, on the average, a more important factor in success in farming than yield of crops per acre.

It is both easier and more profitable to increase low acre yields than high ones, and a small product per cow than a large one. In other words, profits can be increased more easily by attention to the weakest points in a system of farming. The more vital the weakness, the greater the increase in profits that can easily be made.

With a given type of farming, under given conditions, there is a certain way of dividing acreage among the several enterprises of the farm which is more profitable than any other way; that is, there is a most profitable acreage for each crop. Similarly there is a most profitable proportion of income from each source. If the acreage of any crop or the proportion of income from any enterprise be greater or less than this optimum, the profits of the farm as a whole are lowered thereby.

Certain enterprises may be distinctly profitable when occupying a minor position in the farm business and distinctly unprofitable if made major enterprises. This appears to be true of fruit growing in Chester County, and, to a less extent, of poultry keeping.

On small farms the expense of operation is much greater per unit of product than on large farms of similar type.

Diversity of the farm business is, a a rule, an important factor of success in farming. A medium degree of diversity, sufficient to give food, seasonal distribution of labor, complete utilization of land, and a considerable variety of sale products, is better than either extreme diversity or a low degree of diversity.

These general principles, applying to a wide region in the Middle Atlantic States, have led to important conclusions bearing on possible improvements in Chester County farming. The more important applications of the above principles to the agriculture of the district studied are given below.

The standard rotation of the section, viz. 1st year: corn— 2nd year corn, potatoes and oats— 3rd year: wheat— 4th and 5th years: timothy and clover—should be changed to the following: 1st and 2nd years corn— 3rd year: annual hay crop and potatoes— 4th year: wheat— 5th and 6th years: timothy and clover. Oats are unprofitable in this district

The Chester County farmer should grow a little more corn than he needs for home use. The total hay area (including annual hay crop) should occupy between 40 and 50 per cent of the land under crops. It does not pay to buy hay in this districts, unless the cows are of the highest dairy type. Dairying should normally be the leading enterprise with about one cow to each 4 or 5 acres of cultivated land. The average return per cow for dairy produce is $80 and where the receipts per cow are less than $50 per annum, the larger the herd, the smaller the labour income. More heifer calves should be raised to replace old cows. Bullock fattening is not worth while, as a main line of business, except on large farms where labour is scarce. A few hogs should be fed for market but the district is unsuitable for sheep farming. As regards poultry, 100 to 150 hens are more profitable than larger or smaller flocks. Fruit and garden produce should be grown chiefly for home use. Potatoes probably occupy about their proper place in Chester County farming.

Yields per acre can profitably be increased up to about 40 per cent above the average: beyond this the labour income falls off. The latter increases with the size of the farm, but with small farms of under 40 acres, the income is too low to maintain a good standard of living.

Farms where "diversity" is about the average for the section are usually more profitable than those where farming is either more or less diverse than the average.

The following brief description will serve to show the methods used to collect and classify the data forming the basis of the present study. Chester County was chosen for these reasons: The soils of the area are extremely uniform in character, thus giving uniformity to the farm practice of the district and permitting comparison to be made without the disturbing element of variations in type of soil; the district has long since passed the stage of pioneer farming, so that the forces which control the type of farming have had sufficient time to assert themselves and produce a highly stable agri-

ulture, which now changes only when economic or other conditions change. he local agriculture therefore lends itself admirably to a study of the fun- mental principles of farm organisation.

This report, relating to the period March 1, 1911 to March 1, 1912, cludes as has been stated above, the analytical study of 643 farms. For ch of these a valuation has been made of all farm property; the propor- on of capital invested in land, buildings, live stock, implements and machi- ry, supplies and cash for current expenses; the source of income and the mount from each; the value and amount of expenditures; and numerous her items bearing on profit in farming.

Besides this general study of each farm a full account is given of the ography, topography, geology and drainage systems of the district. Fur- er the agricultural history of the area is surveyed, principally since 1840, hen the decennial census of live stock was begun as part of the Government heme of agricultural statistics. Table I gives some idea of the profound anges that occurred in eastern agriculture during the decade 1840-50. bout this time there was an enormous extension of agriculture in Ohio d the Mississippi Valleys. Later, about 1870, the city of Philadelphia gan to exert its influence on the local farming, and, with the increasing wn populations of the neighbourhood, the dairy side of the industry be- me dominant.

BLE I. — *Census data showing changes in the agriculture of Chester County.*

Live stock and crops	1840	1850	1860	1870	1880	1890	1900	1910
y cows	16 000	19 604	25 900	32 700	42 400	49 300	45 700	45 400
r cattle	45 000	35 500	29 900	21 100	18 400	12 000	21 700	19 700
e	64 500	36 600	31 500	28 200	34 000	35 600	30 500	21 400
p.	56 700	13 400	11 700	13 100	15 100	11 200	9 900	5 300
sold (thousands of gallons)	—	—	—	1 598	5 759	24 000	17 038	20 206
er produced (thousands of nds)	—	2 092	2 730	2 848	4 247	1 628	1 314	573
t (thousands of bushels)	438	547	801	754	775	882	785	928
y thousands of bushels)	45	2	5	1.6	0.9	0.2	0.2	01.2
(thousands of bushels)	1 080	1 146	1 227	1 034	1 137	868	925	777
(thousands of bushels)	86	52	32	12	20	19	22	27
and forage (thousands of s)	826	1 339	1 590	1 540	1 965	1 959	2 687	1 882
	78	96	94	115	126	162	131	142

In order to make the comparisons on which the bulletin is based of value, it was necessary to limit the work to the 378 farms on which farmer himself took a man's part in the work of the farm. This involv- he rejection of: 16 farms owned and managed by women who did none e farm work; 24 farms run by paid managers; 27 farms devoted wholly

TABLE II. — *Utilisation of land and value of real estate.*

Sizes of farms in acres	Number of farms	Average size	Tillable area	Crop area	Tillable pasture	Other pasture	Wood-land	Waste land	Value of real estate per acre	Pasture (1)
		Acres	%	%	%	%	%	%	$	%
13 to 40 .	54	28	75	67	8	9	5	11	123	
41 to 60 .	61	52	72	62	10	10	8	10	94	
61 to 80 .	60	73	72	63	9	11	7	10	91	
81 to 100 .	68	93	71	62	9	10	10	9	91	
101 to 120 .	52	110	71	60	10	12	8	10	86	
121 to 160 .	61	136	66	58	7	13	11	11	84	
161 to 393 .	22	203	73	58	14	10	11	7	87	
All sizes . . .	378	90	71	61	10	11	9	9	90	

(1) Per cent pasture is of total crop and pasture area.

TABLE III. — *Distribution of crops.*

Acre groups	13 to 40	41 to 60	61 to 80	81 to 100	101 to 120	121 to 160	Over 160	All farms
Number of farms	54	61	60	68	52	61	22	378
Corn	23.7	22.1	20.5	19.6	20.4	18.2	18.3	
Silage	0.6	0.2	1.3	2.0	3.0	2.8	5.7	
Total corn . . .	**24.3**	**22.3**	**21.8**	**21.6**	**23.4**	**21.0**	**24.0**	
Potatoes	7.9	8.5	5.8	6.8	5.9	4.9	4.9	
Wheat	17.4	18.9	19.5	18.3	17.6	18.3	16.9	
Oats	4.8	5.3	6.3	6.7	6.1	6.4	7.5	
Hay	39.9	40.2	44.3	43.8	42.7	47.2	44.6	
Fruit	3.7	3.0	2.2	2.3	3.8	1.9	1.5	
Truck	1.5	1.4	0.1	0.1	0.2	0.1	0.3	
Special (*a*)	—	0.2	—	—	—	—	—	
Miscellaneous (*b*)	0.5	0.2	—	0.4	0.3	0.2	0.3	
Total . . .	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	

(*a*) Tobacco. — (*b*) Millet, rye, etc.

hot-house business, mainly mushrooms; also 57 tenants paid cash rent, a half-share, and 14 who furnished only labour and received 1/3 of the rm produce. Other records were incomplete and were discarded.

The uniformity desirable in a study of this kind is maintained in the 8 farms dealt with in Tables II, III, IV, and V, where they are divided to 7 classes according to their size.

TABLE IV. — *Animal units* per 100 acres of crops.*

Kind of live stock	Size of farms in acres							All farms
	40 or less	41 to 60	61 to 80	80 to 100	101 to 120	121 to 160	Over 160	
y cows	20.3	21.2	19.1	19.7	23.2	19.2	18.4	20.4
f cows	0.5	0.3	0.8	0.5	—	—	—	0.3
ng cattle	1.6	2.3	2.0	2.3	2.3	2.4	2.6	2.4
s (a)	0.1	0.4	0.4	0.6	0.8	0.7	0.8	0.5
rs	0.1	0.3	2.3	0.5	—	0.8	4.6	1.2
ws	11.2	8.9	7.7	7.2	6.8	6.2	6.3	7.2
s (a)	0.1	0.3	0.5	0.4	0.1	0.7	0.6	0.4
ep	—	0.1	0.1	0.2	0.8	0.4	0.7	0.4
gs	1.6	0.9	0.4	0.9	0.9	2.0	1.2	1.1
dairy	4.5	2.7	2.5	2.1	1.5	1.4	0.7	2.0

(a) Number of animals per farm.

* One animal unit equals one or other of the following groups of animals, which consume equivalent units of food: 1 adult horse = 1 dairy cow = 2 young cattle = 5 pigs = 7 sheep = 100 poultry.

The writers have especially endeavoured to find out how the system of ing and the method of valuing the produce, affects the labour income f the farmer. Thus the farms have been divided into different classes, rding to the percentage of their total area devoted to each type of crop, also according to the total cash receipts derived from each crop and different branches of animal production. For each of these classes adjusted labour income" has been determined. This index has been en rather than the actual labour income of the farmer, so as to eliminate size of the farm as far as possible. The farms, divided according to , have each been assigned as an index for labour income, the percen-

1) The labour income of the farmer is what remains of the gross profit after deducting all ses and interest on capital at 5 per cent. The labour of the farmer's family is reckoned among the expenses at the equivalent wages. Produce consumed by the farmer's family included. (*Ed.*).

tage relation of the income actually realised to the average or normal income of the class to which the farm belongs. Thus if the normal income is called, 100 for each class, the index varies as a function of the factors which can, in their turn, be isolated and studied according to the method described below. Table VI, for instance, gives only the detailed figures for corn (maize). Here are set out the limits, for the district studied, between which the adjusted labour income of the farmer varies, as a percentage of the total area under this crop, and as a percentage of the total cash receipts derived from the sale of corn, beyond that fed to stock on the farm.

TABLE V. — *Distribution of receipts.*

Size of farms in acres	13 to 40	41 to 60	61 to 80	81 to 100	101 to 120	121 to 160	Over 160	All farms
Number of farms	54	61	60	68	52	61	22	378
	%	%	%	%	%	%	%	%
Source of income:								
Dairy products	28.9	33.1	35.9	38.0	48.1	39.5	40.5	39.1
Dairy cattle	4.9	6.4	5.8	5.7	3.3	4.8	4.4	5.0
Beef cattle	0.2	0.1	2.5	0.8	—	1.8	4.8	1.5
Horses	0.1	0.3	1.4	0.1	0.2	0.5	0.3	0.4
Hogs	4.5	2.8	1.2	2.8	2.6	3.8	2.3	2.8
Sheep and wool	—	0.1	0.1	0.3	0.9	0.4	1.1	0.5
Poultry and eggs	18.7	11.6	11.7	8.5	6.0	6.4	3.3	8.2
Corn	1.2	2.5	2.5	2.1	2.3	2.2	3.1	2.3
Potatoes	9.3	12.4	8.6	11.0	8.2	6.9	7.5	8.
Wheat	5.8	8.2	9.4	8.4	8.5	9.0	8.0	8.
Oats	0.2	0.2	0.2	0.1	0.1	0.2	0.3	0.
Hay	9.6	10.0	13.4	13.6	12.4	18.4	16.9	14.
Fruit	1.4	1.3	1.0	1.0	0.6	0.2	0.2	0.
Truck	3.0	1.8	0.1	0.1	0.2	(*d*)	0.4	0.
Special (*a*)	0.7	0.7	—	—	—	—	—	0.1
Miscellaneous (*b*)	5.1	4.2	3.1	3.9	1.7	1.9	2.7	2.9
Feed and supplies (*c*)	6.4	4.3	3.1	3.6	4.9	4.0	4.2	4.

a) Sweet peas, 1 farm; tobacco, 1 farm. — *b*) Miscellaneous crops (rye, millet, straw, etc), labor, lumber, or wood sold, etc. — *c*) Increase in inventory. — *d*) Less than 0.05 per cent.

The practical conclusions drawn from these statistical data have been given already. It will be sufficient to note the fact that the course followed by the most able farmers is fully justified. They have increased their corn production to suit the changed economic conditions, while the majority of their fellows lag behind and continue to grow corn chiefly for consumption on the farm.

TABLE VI. — *Relation of corn to crop area and labour income.*

Per cent of crop area in corn	0 to 19	20 to 29	30 to 39	40 +
Number of farms	138	188	42	10
Adjusted labor income	94	102	121	52

Average percentage of corn area on the 378 farms, 22.3.

Per cent of income from sale of corn	None	1 to 19	20 +
Number of farms	251	121	6
Adjusted labour income	95	113	55

The average labour income for farms classified according to size is set ut in Table VII. This also shows the number of farmers in each class who eached an income of $1000 or more.

TABLE VII. — *Relation of size of farm to labour income.*

Size of farms, in acres	Number of farms	Average size	Average labour income	% of farms with labour income $1,000 or more
		Acres		
13 to 40	54	28	$240	6
41 to 60	61	52	550	10
61 to 80	60	73	730	25
81 to 100	68	93	848	34
101 to 120	52	110	957	46
121 to 160	61	136	1 094	46
161 to 393	22	203	1 575	68
Average	378	90	789	30

Study of the relation of size of farm to efficient use of labour and work- g capital has led to the collection of data given in Table VII. These are eresting both on their own account and because they explain the results own in Table VII.

TABLE VIII. — *Relation of size of farm to efficiency.*

Sizes of farms, in acres	Number of farms	Productive work units per farms		Crop acres per man	Man labour per crop acre	Value of labour per month per man	Crop acres per work horse	Work horses per man	Value of machinery per crop acre	Ratio of cost of buildings to farm income
		Man	Horse							Dwelling
13 to 40 . .	54	184	82	13.7	$20.74	$23.93	9.0	1.5	$15.11	3.41
41 to 60 . .	61	299	140	20.2	15.78	26.60	11.9	1.7	12.57	2.19
61 to 80 . .	60	372	177	23.2	13.98	27.12	13.9	1.7	11.92	1.88
81 to 100 .	68	475	226	25.2	13.46	28.30	14.5	1.7	10.79	1.76
101 to 120 .	52	551	259	25.6	13.64	29.22	15.0	1.6	11.80	1.83
121 to 160 .	61	582	286	29.0	11.80	28.50	16.8	1.7	9.20	1.62
160 + . . .	22	856	444	31.1	13.05	33.77	17.4	1.8	8.94	1.68
All sizes .	378	439	211	27.7	13.69	28.27	14.7	1.7	10.88	1.88

The relation of the labour income to the number of days' work f men and horses for farms divided into four groups based on the numb of man-work units (productive days' work per farm) is recorded in Table IX

TABLE IX. — *Relation of units of work to labour income.*

Man work units per farm	Number of farms	Man work units per farm	Horse work units per farm	Average size of farm	Labour income	Adjust income
				Acres	$	Per ce
300 and less	117	211	111	49	836	78
301 to 500	129	395	198	88	703	94
501 to 700	89	588	278	116	1 083	121
701 and over	43	878	378	151	1 668	152
Average . . .	378	439	211	90	789	100

Table X brings out a point of special interest. The small farm cannot afford an adequate equipment of labour-saving machinery, and th

relative expense of implements is greater because of the smaller use that can be made of them.

TABLE X. — *Relation of size of farm to use of machines.*

Size of farms . . . . . acres	60 and less	61 to 100	101 to 160	Over 160	All farms
Number of farms	115	128	113	22	378
Items of equipment (1)	Per cent of farms reporting	Per cent of farms reporting	Per cent of farms reporting	Per cent of farms reporting	Per cent of farms reporting
Disk harrow	22	27	39	64	31
Roller	78	91	94	96	88
Corn planter	43	63	74	82	61
Grain binder	31	70	84	86	63
Grain drill	49	74	90	96	73
Hay loader	—	5	23	27	10
Hay tedder	51	69	81	86	68
Manure spreader	36	65	82	100	63
Mower	3	12	24	45	15
Silage cutter and feed grinder .	26	44	50	64	42
Spring tines	23	38	50	64	38
Steam separator	16	9	10	5	11

(1) Practically all farms reported wagons, buggies, plows, harrows, mowers, rakes, cultivators, and ness.

With regard to the relation of yield per acre to the size of farm, it is portant to note that the yields on the small farms are no greater than on e large. There appears to be very little relation, on the farms in this trict at least, between the size of farm and yield per acre for any kind of p.

On the other hand, there is a very distinct relation between the yield acre and the labour income. The writers make this point clear by ulating the adjusted labour incomes of the farms in the district divided ording to the "crop index" of the group to which each farm belongs. is, if the *average* quantities of different crops, a, b, c... are produced on otal area *x*, and if on a particular farm it is necessary to devote to the duction of the same quantities an area *y*, then the "crop index" for t farm is given by x/y.

In Table XI the farms are divided according to the crop index of each n. It is evident that good yields (crop index 100-140) are more profit- than very high yields and much more profitable than very small ds.

TABLE XI. — *Relation of crop index to labour income.*

Crop index	Number of farms	Average labour income	Average adjusted income	Average size of farms
			%	Acres
84 and less	75	360	49	89
85 to 99	91	616	74	90
100 to 114	107	870	108	89
115 to 139	92	1 183	153	91
140 and over	13	1 005	130	82
Total . . .	378	789	100	90

TABLE XII.

Divided according to receipts per cow	Number of farms	Receipts per cow	Adjusted income	Labour income
			%	
50 and less	48	$42	55	$418
51 to 60	43	63	102	592
61 to 70	27	57	92	783
71 to 80	51	75	99	782
81 to 90	24	86	111	831
91 to 100	39	96	137	1 185
101 to 120	29	110	162	1 422
Over 120	28	138	175	1 602
Total . . .	289	80	111	966

TABLE XIII.

Diversity index	Number of farms	Average labour income	Average adjusted income	Average size of farms
			%	
Less than 1 to 2.9	79	$663	82	83
3 to 3.9	107	718	90	90
4 to 4.9	125	888	114	94
5 and over	67	866	112	90
Total . . .	378	789	100	90

	Acres							Total owner farms	Special farms	Total for tenant farms	Land-lord's expenses	Cash-rent tenant	Share-rent tenant
	40 and less	41 to 60	61 to 80	81 to 100	101 to 120	121 to 160	Over 160						
Number of farms	54	61	60	68	52	61	22	378	27	124	124	53	71
	%	%	%	%	%	%	%	%	%	%	%	%	%
Paid labour	13.0	15.4	24.4	28.5	24.6	30.7	36.1	26.8	37.4	23.5	1.2	19.3	35.0
Board, paid labour	4.2	4.6	6.1	7.1	5.8	6.0	3.5	5.6	3.6	5.6	0.1	4.3	8.8
Family labour	16.4	16.2	10.1	7.7	12.9	6.9	5.0	9.6	4.1	9.4	1.5	6.4	15.1
Machinery repairs	1.5	2.3	1.4	1.6	2.0	1.3	1.6	1.6	1.3	1.6	0.7	1.2	2.0
Building repairs	2.7	1.9	1.2	1.2	1.2	1.2	0.1	1.8	0.7	1.8	3.6	1.8	0.2
Fence repairs	1.4	1.1	0.9	0.8	1.4	0.8	0.7	1.0	1.0	1.3	4.3	0.2	0.2
Drain repairs	—	0.1	—	0.1	—	—	0.2	0.1	—	—	0.1	—	—
Feed, silage, etc.	1.1	0.7	1.1	0.6	1.1	0.6	1.7	0.9	0.1	0.9	0.8	1.1	0.4
Feed, grain, etc.	24.7	19.0	18.1	17.5	19.7	16.0	21.3	18.7	7.6	22.0	26.7	18.4	16.1
Feed grinding	1.6	1.8	1.4	1.5	1.1	1.3	1.1	1.3	0.3	1.5	1.8	1.1	1.4
Ice and milk haul	—	—	0.6	—	1.0	0.3	—	0.3	—	—	—	(a)	(a)
Horseshoeing	2.7	2.9	2.5	2.3	2.0	2.0	1.3	2.1	1.1	2.4	0.9	1.8	3.2
Breeding fees, vet	0.9	0.7	0.8	0.7	0.7	0.7	0.7	0.8	0.7	0.9	0.6	0.9	0.6
Seeds, plants, etc.	3.9	5.8	4.3	5.1	3.4	4.5	3.6	4.3	2.2	3.9	6.8	2.6	2.5
Fertilizer	11.3	13.1	13.5	12.0	11.4	13.0	11.3	12.3	20.8	11.2	20.1	7.8	6.1
Spray material	0.1	0.1	—	0.1	0.1	—	—	—	0.1	—	0.1	(a)	0.1
Twine	0.2	0.4	0.4	0.4	0.3	0.4	0.3	0.4	0.1	0.4	0.2	0.3	0.4
Thrashing	1.4	1.4	1.6	1.4	1.2	1.5	1.3	1.4	0.4	1.4	1.4	0.9	1.4
Pressing	1.0	1.7	2.0	1.8	1.8	2.5	2.1	2.0	0.8	1.6	1.8	1.0	1.6
Machine hire	0.5	0.6	0.3	0.3	0.3	0.2	—	0.2	0.1	0.3	0.1	0.3	0.2
Fuel, oil, barrels, etc.	0.5	0.6	0.6	0.7	0.7	0.7	0.6	0.7	6.6	0.6	0.5	0.5	0.7
Insurance	2.7	2.1	1.9	1.8	1.6	1.9	1.9	1.9	1.2	2.2	6.0	0.7	0.9
Taxes	8.0	7.3	6.8	6.7	5.8	7.4	5.6	6.7	3.3	7.3	20.2	2.5	2.9
Miscellaneous	0.2	0.2	—	0.1	—	0.1	—	0.1	0.1	0.2	0.5	(a)	0.2
Mushroom spawn	—	—	—	—	—	—	—	—	6.4	—	—	—	—
Cash rent	—	—	—	—	—	—	—	—	—	—	—	26.9	—
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	1.000	100.0

(a) Less than one-tenth of 1 per cent.

The relation of the receipts per cow to the labour income is of the firs importance in a district devoted to dairy farming and this is set out in Ta ble XII. No farmer in this district went to too great an expense to obtai a high yield of milk per cow.

In a similar way the labour income has been studied in relation to the combined effect of crop index and receipts per cow, the efficiency of farm labour and the " diversity index " of the farm. The last term requires some explanation ; it might also be called the " specialisation index ". To find this index : Take the sum of the costs for each branch, divide the cost of each branch by this sum, square each quotient, and divide unity by the sum of these squares. The relation of diversity index to labour income is given in Table XIII.

Table XIV shows in detail the nature and relative amount of expenditure for various purposes on farms of different sizes, on special farms, on cash-rent farms and on farms run on a share basis.

The writers have calculated also : the feeding cost per animal unit . the area under cereals, hay and pasture per animal unit — the amoun of silage made and fed per head of cattle, divided according to the amoun of stock on each farm — the rate of depreciation of dairy cows and farm horses — the value of farmyard manure per animal unit. These are the chie points in the complete analytical study which includes fifty tables o numerical data.

1115 – **Study of a Small Holding at Kirberg, District of Wiesbaden, Germany.** — BENDER, EMILE, in *Illustrierte Landwirtschaftliche Zeitung*, 35th. year, Nos. 99 and 100 Berlin, December 11 and 15, 1915.

INTRODUCTION. — Taking as basis the classification of agricultural holdings adopted by the Imperial Bureau of Statistics (1), small and medium holdings occupy 81 per cent of agricultural land in the district of Wies baden. In all Prussia the Wiesbaden figure is only surpassed by the distri of Lunebourg, with 86 per cent of its area in small and medium holding But if we compare the number of holdings improved by the owners, whos chief occupation is agriculture, the district of Wiesbaden takes the lead wit 182 holdings per 2471 acres (1000 ha.), with the exception of the district c Coblence. Nassau, district of Wiesbaden, is clearly a typical country o small and medium proprietors as well as of small and medium holdings

Situation, Climate, Extent and Distribution. — The holding studied lie in the old market town of Kirgberg, near Limburg, 7.5 miles from the coun ty town and 47 miles from the railway station at Niederbrechen. Th climate is temperate ; altitude varies from 574 to 984 feet. The country is slightly undulating and includes about 1000 acres of public woodland and 2 220 acres of arable fields and meadows (meadows : 10 per cent), o which about 370 acres are estate (Domänen) and 216 acres are in trust (Fid dei-Kommis, or land let out in plots of 6.2 to 9.3 acres). The areas of th

(1) Small holdings : less than 5 acres. Medium holdings 5 to 250 acres. Large hold ings : over 250 acres.

holding in the township are fairly uniform, ranging from 6.2 to 37 acres only.

The holding taken as a type has an area of 31.66 acres divided as follows:

Arable	28.37 acres	89.6 per cent
Pasture	3.29 "	10.4 " "

The arable land is divided into 45 plots, varying in size from 0.31 to 54 acres. These are cultivated on the three course rotation, usual in this district.

Cultivation. — Rye follows potatoes or fodder-beets; in 1914, the year to which the report refers, it occupied 6.0 acres.

Wheat follows clover and beets (harvested late) on 2.74 acres. Before sowing, the grain is treated with 2 per cent solution of copper sulphate. An area of 0.90 acres, also sown with corn, had to be resown to oats, as the wheat was damaged by crows and mice.

The stubbles are turned in by surface ploughing, followed by the harrow. In autumn harrowing and deep ploughing is done, then, in spring, another harrowing precedes the drill The amounts of seed used are as follows:

	bushels per acre	area sown
Oats "Beseler II"	2.5-3.2	5.06 acres
" "Lochow Gelbhafer"	2.3-2.5	1.80 "
Barley mixed with clover	—	2.53 "
" without clover	—	0.35 "

The barley most grown is Goldthorpe; on poor soils the earlier sort Schwanenhals has been tried. The barley is used as fodder on the holding, small amount only being sold to the brewery.

Clover occupied, in 1914, 3.0 acres and potatoes 3.8 acres. For the latter the preliminary cultivation of the soil is very thorough. Stubble is turned in and dung ploughed under, followed by light harrowing. In autumn deep ploughing and in spring the Cambridge-roller and the harrow are used, and lastly the furrows are made with the ridge-plough. After planting, the furrows are closed by the ridge-plough then, according to circumstances, comes the roller, the Cambridge-roller or the harrow. Later the horse-hoe and hand weeding are employed between the rows and finally the ridge-plough is used again.

Modrows Industry is the potato most favoured and, as early varieties, the following are grown in turn: Kaiser Krone, Gelbe Zwickauer, Ella and Royal Kidney.

In 1914, 2.5 acres were devoted to beets following oats. The soil is prepared in the same way as for potatoes, the seeds are either sown at 10 inches apart then planted out at the end of May or sown direct with the drill. For some years past, sorts specially selected for yield have been used, no-

tably Leutewitzer for sowings intended to be replanted and Eckendo for sowing direct.

Manure. — The abundant stock supplies plenty of dung and liqui manure as much concentrated food is bought and the manure is carefull stored. The latter is only applied to the roots at the rate of 20 tons per acre Potatoes get besides 268 lbs. of " A. S. 7×9" (ammonium superphosphat giving 7 % ammoniacal nitrogen and 9 % water soluble phosphoric acid with 134 lbs. of potash salt.

Beets receive the same manure, plus 8000 to 9000 galls. of liquid ma nure and268 lbs. of kainit per acre ; while rye has 268 lbs. of " A. S. 7 × 9' 535 lbs. of basic slag, and 9.000 galls. of liquid manure. Wheat is not ma nured after clover ; after beets, 535 lbs. of basic slag followed by 71 lbs of nitrate of soda in spring. Oats are given 268 to 357 lbs. of " A. S. 7×9" and, on poor land, a little liquid manure. Barley mixed with clover receives 535 lbs. of slag and 357 lbs. of kainit per acre ; pastures are manured in a similar way.

The soil has been examined by the Weileburg School of Agricultu and found to be very deficient in lime. Potash salts are not much used i the district, yet they are very effective as shown by the following experimen made in 1911 :

Manure (plots of 0.62 acre)	Yield of beets
12.3 tons of dung + 2,200 galls. of liquid manure + 110 lbs. of super	15.06 ton
12.3 tons of dung + 2,200 galls. of liquid manure + 110 lbs. of super + 330 lbs. of kainit	18.06 "

The beets from the plot dressed with kainit kept much better than those from the other plot.

Yields. — The following Table gives the yields from 1896 to 1913

Average yields per acre.

Year	Rye (Bushels)		Wheat (Bushels)		Oats (Bushels)			Barley (Bushels)		Potatoes (Tons)							Hay (Tons)
	Old local rye	Petkuser	Molds red prolific since 1902	Square head	Heines Ertrag reichster	Beseler II	von Lochows Gelbhafer	Old local barley	Goldthorpe	Magnum Bonum	Up to date	Sass	Cimbals Neue Export	Professor Wohltmann	Industrie	Précoce	Meadow hay [illegible]
Average 1896-1905	37.2	—	33.3	—	56.3	—	—	30.3	—	6.65	—	—	—	—	—	—	2
1906	43.6	—	34.0	—	43.3	—	—	35.0	—	5.97	—	—	—	—	—	—	—
1907	39.6	—	33.7	—	55.2	—	—	39.2	—	3.38	—	7.40	6.45	—	—	4.62	3.
1908	34.0	—	31.4	—	59.9	68.8	—	37.0	—	—	7.80	6.29	8.92	6.37	—	4.94	3
1909	39.0	48.9	34.6	36.1	—	70.1	—	—	53.2	—	9.32	—	9.87	5.33	7.01	5.50	4
1910	—	47.2	39.1	—	—	73.5	—	—	34.1	—	5.18	—	7.96	3.23	8.36	4.86	4
1911	—	54.8	40.5	—	—	84.5	—	—	52.2	—	8.16	—	—	4.38	7.80	5.73	4
1912	—	47.2	41.4	—	—	82.4	—	—	49.7	—	9.40	—	—	—	9.40	8.20	5
1913	—	46.4	39.7	—	—	85.4	91.8	—	58.0	—	3.43	—	—	—	11.15	7.80	6

The exact yields of straw and beet are not known. With regard to
eat Molds Red Prolific was chosen in 1911 as it stands cold well and the
ain, owing to its good milling quality, fetches a better price than other
reign sorts grown in the district. Squarehead does not stand the winter
ll and yields poorly, so it has been given up. Criewener 104, a good
elder but rather late, has also been tried as well as Strubs square.

Broad casting was dropped in 1911; the drill was introduced very
pportunely, as this year was exceptionally dry.

Agricultural improvements. — The old organisation was changed in
he autumn of 1905 and from this date progress has been rapid. For-
erly the approaches to the holdings were sown and their use forbidden
y police order, from seed time to harvest. Now, plots of less than 0.3
re have vanished, and the area includes only 4600 plots instead of 8000.
nfortunately they are still too small for harvesting machines to be used.

Other agricultural improvements are: new drainage systems and re-
r of existing systems; clearing of watercourses and levelling of the soil.

Stock. — The holding studied carried 14 head of cattle, equivalent
ne animal, weighing 1 100 lbs. to 2.9 acres, compared with one animal
5.7 acres for the period 1896-1905. The increase is due to the growth
egetable produce and the dearness of meat. Efforts are made to obtain
ood yield of milk, as well as to find animals well shaped and easy to
ten; the average weight of each cow which varied from 992 to 1 047 lbs.
to 15 years ago, is now 1 272 lbs. The yield of milk has also gone up from
0 to 620 galls. in 1906 to 700 galls. in 1913. The stock is grazed on the
rish land for the first year, for the second year on the Simmenthaler
sture in the Oberlahn district.

The holding supported an average of 18 pigs, with a live weight of 89
112 lbs. per acre. Breeding has been given up and animals bought
6 weeks are fattened and sold at 6 months.

Public woodland. — The public woodlands, which occupy about 1000
es, are on deep sandy soil; their net yield per acre only reaches 3.s.
ntury ago, one eighth part of these woods was pasture, but the forest
rtment objected to their restoration to their old state.

Labour. — By comparison with the Eastern provinces, the district of
sbaden, thanks to its small holdings, is particularly well off with regard
abour. It took only 835 out of 367 364 foreign labourers employed by
man agriculture, whose importation was approved by the "Deutsche
eitzentrale" for 1912-13.

With regard to the transfer of rural property, it should be noted that
asant takes over this father's holding when he is about 35 years old.
father can still look after the stock and the mother manage the home.
n one or two of the brothers or sisters of the young holder are unmarried
help him as paid workers. Otherwise he hires a labourer or woman
ker. The children of the holder also help on the holding. After some
s hired labour can be replaced by that of his grown up children. The
er enlarges his farm by buying or renting new plots; he saves money
ys off his debts. Between 24 and 26 the eldest son marries and settles

down with his wife in the parental home. The old people continue to manage the holding for some years. The young wife brings as her dowry some land and often a little money. These plots are worked along with the parents' holding to the advantage of the young couple who thus begin at once to increase their property.

1116 - **Statistical Report on the Influence of Distance from Market on the Value of Rural Property in Missouri, U S. A.** — JOHNSON, O. R. in *Freeman's Farmer*, Vol. 70, No. 5, p. 11. North Jakina, Wash., May, 1916.

The statistical report, by the Missouri Agricultural Experiment Station, on 650 holdings in Johnson county, was designed to show within what limits distance from market affected the value of the holdings, and has given the following results:

Class	Distance from market	Number of holdings per class	Mean value per acre $
I	2 miles	79	78
II	4 »	183	70
III	6 »	126	61
IV	8 »	113	55
V	10 »	149	56

Class	Value of holding per acre $	Number of holdings per class	Distance from market miles
I	more than 100	42	2,5
II	80-100	62	3,0
III	60- 80	275	5,0
IV	40- 60	246	6,2
V	less than 40	25	5,5

The low unit value of the 25 holdings in group V is largely due to the poor quality of the soil; this factor is here more important, in fixing the value, than distance from market.

AGRICULTURAL INDUSTRIES.

INDUSTRIES DEPENDING ON PLANT PRODUCTS

1117 - **The Use of Cider Apples and Cane Sugar in a Beet Sugar Distillery.** — GAILLARD E. in *Comptes Rendus de l'Académie d'Agriculture de France*, Vol. II. No. 24, pp. 676-681. Paris, 1916.

At the beet sugar distillery of Oisement, in the department of the Somme, experiments were carried out on the mixing of cider apples and cane sugar with sugar beet, or sugar beet molasses.

The apples were treated in two ways; they were either mixed with sugar beets in the washing machine and then cut into the usual long narrow slices and handled as beets, or they were put into the diffusion cylinders alone in the form of thin flat slices $^1/_8$ in. thick. As apples contain very little

east food a certain number of the diffusion cylinders were charged with eet and each day some juice was withdrawn from them and added toge- her with nutrient salts to the apple slices in order to assist fermentation. he yield of alcohol from the apples was taken as the difference between he total yield and that of the added beet juice. It amounted to not quite o gallons of rectified alcohol (100°) (rectified spirit and fusel oil) per ton f apples. It should be borne in mind that the experiment was carried ut at the end of December 1915 and during the month of January 1916, or n other words at a season when the sugar content of apples was daily lecreasing.

In the case of cane sugar, a starter was prepared at the outset, using solution of beet molasses of a density of 1.055 to 1.060 and containing 2.4 o 2.5 gms. of acid per litre (expressed as sulphuric acid). To this, nutrient alts were added at the rate of 0.5 per cent of sulphate of ammonia and 0.6 f phosphate of soda. The starter was inoculated with yeast obtained rom a grain distillery and fermentation was kept active by aeration. For he experiments, large vats of about 5000 gallons capacity were used and hese were one third filled with starter. The cane sugar juice acidified till t contained 0.7 to 0.8 gm. of acid per litre, was then run into the vats on he top of the starter, the proportion of cane to beet sugar rising very gra- ually from 4 :20 to 80 :20. It was found that 18.3 lbs. of cane sugar were equired to produce 1 gallon of rectified alcohol (rectified spirit and fusel il). The cane used had a polarisation value of 92.

18 **Refraction Constants of Various Vegetable Fats and Oils.** — HEIM, F. in *Bulletin de l'Office colonial*, Vol. IX, No. 102-103, pp. 267-276. Melun, 1916.

A number of vegetable fats and oils originating from the French co- nies were examined at the French Colonial Office with a view to determin- g the relationship, if any, between their refractive indices and other con- ants of common use, and their chemical composition.

The samples were ground in a mill and extracted in the cold with ether which was afterwards distilled off in a warm bath, the residue being nally raised to 100° C. to drive off any remaining traces of benzine. Fats oils thus obtained were filtered before having their refractive indices termined in a Fery refractometer. The results are set out in the adjoin- g table, and the writer draws the following conclusions:

1) The determination of the index of refraction yielded a very reliable eans of estimating the chemical purity of any fat or oil. For instance the l of *Thea sinensis* gave a refractive index of 1.4707 to TSUJIMOTO in Ja- n, and an index of 1.4706 in the present investigations. Other constants owed far greater variation more especially those resulting from chemical sis; it would therefore appear that the measurement of physical cha- cters is a much more accurate guide to the purity of fats and oils than that of the chemical characters.

2) Except in the case of *Ricinodendron africanus* the index of refraction ways varied with the iodine value.

3) As a rule the index of refraction increased as the saponification

Composition and Cons

Oil seed	Botanical family	Fat constants							
		Density	Melting point	Acid value	Saponification value	Reichert value	Hehner value	Iodine value	Ind of refrac
			°C						
"Karité" *Butyrospermum Parkii* Kotschi	Sapotaceae	0.900 (32°)	32°	7.7	196	1.1	95.25	69.6	1.4
		0.917 (15°)	Solidif. 17-18°	—	192	—	—	67.2	
Dumoria Heckeli A. Chev.	Id.	0.956 (15°)	34°	5.6	188	0.8	96.8	56.4	1.4
Ricinodendron Africanus Muell. Arg.	Euphorbiaceae	0.937 (15°)	20°	16.8	185	1.5	93	87.6	1.5
Hevea Brasiliensis Muell. Arg.	Id.	0.930 (15°)	26°	57.4	206	—	—	128.3	
		0.924 (15°)	—	29.9	185.6	0.5	96.4	133.3	1.4
Symphonia lævis	Clusiaceae	0.872 (20°)	15–16°	8.4	189	1.65	94.3	66.7	1.46
Symphonia Louveli	Id.	0.879 (20°)	15–16°	8.4	189	1.65	94.1	67.6	1.46
Carapa microcarpa A. Chev.	Meliaceae	0.895 (15°)	16°	8.4	188	3.3	92	58	1.46
Sacoglottis Gabonensis Urb.	Humiriaceae	0.900 (15°)	— 2°	—	188	5.5	—	85.8	1.47
Pentadesma butyracea Sabine	Clusiaceae	0.899 (15°)	32°	16	193	0.3	95.2	68.5	1.45
Balanites Thieghemi	Simarubaceae	0.908 (15°)	liq.	9.4	—	6	92.5	121	1.47
"Aouara" (pericarp) *Astrocaryum vulgare* Mart.	Palmaceae	0.916 (15°)	—	31.4	196.8	—	—	75.2	
		0.887 (19°)	—	—	184	—	—	—	1.46
Idem (kernels)	Id.	—	29°3	9.6	242.9	—	—	10.7	1.45
		0.915 (17°)	30°	—	214	—	—	9.6	
Thea Sinensis Linn.	Cameliaceae	0.910 (15°)	liq.	7.5	176.6	15.5	86.5	72.6	1.47
		0.917 (15°)	Solidif. 10°	0.74	191.9	0.66	—	90.4	1.47
Funtumia elastica Stapf.	Apocynaceae	0.929 (15°)	liq.	1.8	167.6	12.1	94	139	1.47
Sorindeta oleosa	Anacardiaceae	0.889 (17°)	16–17°	4.9	185	7.92	91.75	132	1.46
"I'Sano" *Ongokea Gore* Pierre	Olacaceae	0.973 (23°)	< — 15°	4.7	206.4	33.5	93	—	1.5
"Moabi" *Mimusops obovata* Pierre	Sapotaceae	0.894 (30°)	32–33°	56	238.0	11.5	88.25	57.1	1.46
Chrysophyllum Congoense	Id.	0.870 (15°)	31°	68.5	175.7	1.76	95	49.9	1.46

rious Vegetables Fats and Oils.

lting int d acids	fatty acids: saturated Per cent.	fatty acids: unsaturated Per cent.	Nature of fatty acids: saturated	Nature of fatty acids: unsaturated	Remarks	Authorities consulted for chemical properties of fats and oils
0	67	33	palmitic stearic arachidic	oleic	yellowish-white	Hébert
,0	—	—	—	—	—	Various
·0	67	33	palmitic stearic cerotic	oleic	yellowish-white	Hébert
0	30	70	myristic palmitic	oleic linoleic	yellow	Hébert
...	—	—	—	—	brown	Imp. Inst.
—	—	—	stearic	oleic linoleic linoleic	—	Imp. Ist.
0.5	40	60	capric lauric margaric arachidic	oleic	yellow	Hébert
0	35	65	capric lauric margaric arachidic	oleic	yellow	Hébert
0.	45	55	myristic stearic palmitic	oleic	yellow	Hébert
-	—	—	—	—	yellow	Hébert
)	90	10	palmitic stearic	oleic	yellowish-white	Hébert
	37	63	—	—	yellow	Hébert
.2	—	—	—	—	dark brown	Bontoux
	—	—	—	—	dark brown	Hébert
	—	—	—	—	yellowish-white	Bontoux
	—	—	—	—	yellowish-white	Hébert
	42	58	capric lauric	oleic	yellow	Hébert
5	—	—	—	—	—	Tsujimoto
	40	60	lauric myristic	oleic	yellow	Hébert
)	76	24	margaric inferior acids	oleic	brown	Hébert
	0	100	none	oleic 15 % linoleic 75 % isanic 10 %	Impossible to determine; Iodine value, very large. dark brown	Hébert
	50	50	myristic stearic palmitic	oleic	yellow	Hébert
	50	50	lauric myristic palmitic	oleic	red brown	Hébert

value decreased. Exceptions to this rule were the oil of " I Sano " and the fat of *Ricinodendron africanus.*

4) No relationship could be traced between the index of refraction and the remaining constants, *i. e.* acidity value, Reichert and Hehner numbers.

5) With regard to the influence of the chemical composition on the index of refraction, it is obvious that the value of the latter must be dependant on the actual constitution of the fat or oil. Inasmuch as each fat or oil consists of mixture of the fatty acids or of the glycerides of the fatty acids the refractive index of the whole substance must be influenced by the refractive indices of its component parts.

If the fat or oil be a true mixture and the optical characters of each of its constituents were known it should be possible to calculate either its refractive index from a quantitative chemical analysis or *vice versa.* But up to the present no other refractive indices beyond those of stearic, palmitic and oleic acids have been determined and the indices of all the glycerides have still to be investigated. Under these conditions it is very difficult to say with any degree of certainty whether fats and oils really consist of true mixtures and whether it will ever be possible to check experimental results by calculated values. The only example at present available in this connection is the fat of *Pentadesma butyracea* which consists of 90 per cent of stearic and palmitic acids with 10 per cent of oleic acid. Its refractive index works out to 0.512 at 79° C. ; practical tests gave 0.530.

INDUSTRIES DEPENDING ON ANIMAL PRODUCTS

1119 – **The Grading of Milk.** — KELLY, E. in *Hoard's Dairyman*, Vol. LII, No. 1, pp. 1 and 6. Fort Atkinson, Wis., July 28, 1916.

The grading of milk is made necessary by the fact that it costs more to produce milk of one quality than of another, and that the producer ought to be paid accordingly. A first attempt to sell a very pure milk in the United States was made about 25 years ago when a " certified " milk was put on the market in New Jersey. This was intended for infants and invalids and was produced under strict medical supervision and at a great expense. Since then several health departments have granted permits for the sale of " inspected " milk which is not of such high quality as the certified milk, but still considerably better than the average supply. Such inspected milk usually fetches one or two cents per quart over and above the current price.

Grading may be done either by the milk dealer from purely business motives, or by the town or state officials for the benefit of the consumers. Three principal factors determine the quality of the milk, *i. e.* its fat content, the number of bacteria it contains, and the sanitary condition of the dairy farm where it has been produced. Some dealers grade milk on the fat content alone, others only on the standard of the cleanliness at the dairy farm, while a few health authorities simply use the bacterial counts.

As an example of payment for graded milk : one large dairy company buys on a schedule in which prices are quoted for each month and for milk with a fat content ranging from 3 to 4.2 per cent. During the six winter months a difference of 4 cents per point is made for each 100 lbs. of milk; in summer the difference is 3 cents per point. This amounts to 40 cents

a pound for butterfat in winter and 30 cents in summer. If the milk contains less than 8.5 per cent of solids non fat, 2 cents per 100 lbs. of milk are deducted for every point below the standard. There are also other deductions made as follows: 5 cents per 100 lbs. of milk if it is received at a temperature above 60° F.; 5 cents per 100 lbs. if it contains more than one million bacteria per cc.; and 2 cents per 100 lbs. if the condition of the home dairy is not satisfactory.

As an example of grading by health authorities, New York City and Newark N. J. recognise four qualities of milk: *A* raw and pasteurised; *B* pasteurised; *C* to be sold only for cooking. Daily sales for New York City are divided as follows:

50 000	quarts of grade	*A* (raw)	at 12 to 22	cents per quart
145 000	" " "	*A* (pasteurised)	10 to 11	" " "
2 305 000	" " "	*B* "	9	" " "

The main requirements for each grade are set out in the adjoining table.

Grades of Milk Sold in New York City.

Grade	Health of cattle	No. of bacteria: Before pasteurisation	No. of bacteria: At time of delivery	No. of marks for conditions under which milk is produced	Temp.	Age at delivery	Remarks
A raw	Tuberculin test and general examination	—	60 000	Equipment. 25 Methods. . 50	50° F	Not more than 36 hours	—
A pasteurised	General examination	200 000	30 000	Equipment. 25 Methods. . 43	50° F	36 hours after pasteurisation	—
B pasteurised	" "	1 500 000 (1)	100 000	Equipment. 20 Methods. . 35	50° F	" "	—
C for cooking	" "	300 000 (2)	300 000	40	50° F	48 hours after pasteurisation	Sold only in cans

(1) Pasteurised in the city.
(2) Pasteurised outside the city.

1120 – **Pasteurization of Milk in the Bottle.** — In *Pure Products* Vol. XII, No 8, pp. 385 392. New-York, August, 1916.

There are at present three methods by which milk is pasteurized: The "flash" or continuous method; the "holder" or intermittent method, and the method of pasteurizing in bottles which is the latest device for the pasteurization of milk.

In the "flash" process milk is heated at 160° to 165° F. for 30 to 60 seconds. This process has the disadvantage that the milk is often heated too high or is scorched, causing the milk to have a peculiar and unpalatable taste. In the "holder" process milk is heated to and kept at 140° F. to 145° F. for 30 minutes. The pasteurized milk should then be cooled and kept at a temperature below 50° F. The "holder" process, in which compartments or tanks are employed, does not give a uniformly pasteurized product since the large volume of milk makes it impossible to heat it uniformly, one corner or section of the tank being always hotter or colder as the case may be. The tank being necessarily divided into compartments or sections, pockets are created making a positive circulation of milk and therefore a uniformity of temperature in the entire vat or compartments impossible. At any rate in both of these methods — the "flash" and the "holder" process — a recontamination, while filling the milk into bottles cannot be avoided. The third method avoids the risk of recontamination, as the milk is first bottled and then pasteurized.

Pasteurization of milk is frequently done very inefficiently, usually owing to ignorance or carelessness. When the heat applied is insufficient either in amount or time of application, disease germs are not all destroyed and as a consequence epidemics of streptococci, sore throat, typhoid fever, etc., have started. In order to obtain a uniform product it is essential that not only the pasteurization process must be given the proper attention but that proper and efficient devices must be applied in the soaking and rinsing of the bottles. It is useless to apply the most complete pasteurizing outfit if the bottles into which the milk is to be filled are not cleaned properly, and, on the other hand, it is insufficient to use a clean bottle if the pasteurization process is incomplete. The Barry-Wehmiller System of *soaking*, washing and rinsing of the bottles, clarifying of the milk, filling and pasteurizing of the filled bottles is said to be the "last word" in the production of a safe milk. A short description of this model plant may serve to give an idea of the arrangement and machinery used.

As soon as the full cans are received from the wagons they are immediately poured through a *screened* receiving pan from which the milk flows into two 2 000 gallon Pfaudler Glass-Lined Receiving Tanks.

The tanks are lined with glass enamel on the interior and the inner shell provided with an outer jacket. Within this jacket circulates brine, which keeps the milk cold. The jacket is insulated externally with cork blocks. At the bottom of the tanks are perforated air pipes through which washed and filtered air is supplied under pressure from the aerator and compressor. The action of this forced air keeps the milk in complete and constant agitation.

The milk kept in tanks is in contact with a much smaller surface than if kept in cans. The surface which 2,000 gallons of milk come in contact with if kept in 200 cans of ten gallons each represents 1.100 square feet whereas if milk is stored in a Pfaudler tank holding 2.000 gallons, it is in contact with but 110 square feet, or just one-tenth of the surface. In other words, by eliminating can storage the surface is reduced 90 per cent. The more surface the milk comes in contact with, and the longer the milk is kept, the higher the chances of an accumulation of bacteria.

When ready for filling, the milk flows from these tanks into a milk pump which forces it to the floor above through a clarifier, thence direct to the bottle filler.

The empty bottle cases are unloaded from the wagons and delivered by a *gravity conveyor* directly in front of the *soaking machine*. The bottles are taken out of the cases and put into the *pockets* of the soaker. The empty cases, after being cleaned, are deposited on a gravity conveyor which carries them to the discharge end of the pasteurizing machine ready to be refilled with pasteurized milk.

Now the bottles pass mechanically through the soaker which consists of a large tank divided into from 3 to 6 compartments, all of which, except the last, are filled with hot water and caustic soda solution. The first compartment of the soaker contains the strongest solution of caustic soda at a temperature of 110°. The following compartments contain solutions of less strength at temperatures as high as 180°. The last compartment is kept filled with fresh water at a temperature of 80°.

The bottles are passed successively through these various compartments, occupying a total time of 20 minutes for the entire process.

After passing through this soaking system, the bottles are delivered mechanically to the outside pressure washing machine, where the outside of the bottles are washed by jets of water under pressure, and the inside is filled with water at the same time, which frees them from the caustic soda solution to which they have previously been subjected. The bottles are then passed mechanically to the large inside pressure washing machine in which they are thoroughly cleaned, each bottle being subjected to five successive washings in the inside. Three of these five washings are by means of water circulated under pressure by a centrifugal pump at 65 pounds per square pressure by a centrifugal pump at 65 pounds per square inch. The final two washings are performed by water directly from the fresh water supply. The water used in these final washings is the only water actually consumed as all the other water is reused.

During this process of interior washing, the bottles are once more washed externally by jets directly from above, which jets are also connected with a pump and supplied by reused water. The greatest efficiency is therefore, obtained with a minimum amount of fresh water expense.

After the final washing, the bottles are delivered mechanically on a brass platform from which they go to the filler.

The filler passes them in a circular direction and fills the bottles at the

rate of from 60 to 90 bottles a minute. Each bottle is filled to a definite line, which can be altered as required.

When filled, the bottles move mechanically to the crowning machine and are capped continuously with seals. The only labour required in this process is to keep the machines supplied with *crowns*.

When this capping process is completed, the work of bottling is considered 90 per cent, finished, as the only remaining work required is to place the bottles by hand into the baskets of the pasteurizing machine.

The pasteurizing process is entirely mechanical and requires one hour and twenty minutes. During this time the bottles are submerged slowly and continuously through the various compartments, bringing the temperature of milk gradually up to 145°. The bottles then are slowly passed through water of this temperature for 25 minutes. After this treatment the bottles continue on their journey through water of gradually decreasing temperature until they finally reach ice-cold water, the passage through which takes 15 minutes. They emerge at the discharge end of the pasteurizer at a temperature of 36°.

The delivery of pasteurized and cooled milk is continuous and is going on all the time the baskets are being loaded from the crowning machine.

The bottles are now taken out of the baskets of the pasteurizer and placed in the original cases which have been delivered as previously described. The filled cases are placed on a *gravity conveyor* which delivers them mechanically into the refrigerating room where they remain until required.

The various sections of the pasteurizer are thoroughly insulated with cork for the cold sections, and asbestos for the hot sections thus preventing radiation of heat and cold and securing maximum efficiency of the apparatus.

The motive power required for running the machines is as follows: The combined soaker and washer is handled by a 6 horse-power motor; the filler and crowning machine each require a ½ horse motor. The large pasteurizing machine is operated by a half horse motor. All these machines are large enough to handle 1 000 quart bottles per hour. The number of operators required for the entire system may be conservatively estimated at six.

The cost of operating this system is as follows: Six men at 15 cents per hour, 90 cents, or 22 ½ cents, per 1000 bottles. Steam and refrigeration, according to records since January 1st, amounted to 75 cents per 1000 quart bottles: crowns for small neck bottles, 80 cents per 1000. This is a total of $ 1.77 per 1000 quart bottles.

This plant of the Steinlage Sanitary Milk Co. is of unusual interest because it marks the beginning of a new application of pasteurization to the milk trade. It is the first milk plant in the United States to adopt the system in its entirety, including the small neck bottles. The Steinlage bottles are the same style as used for grape juice.

The pasteurization of milk in bottles must be considered a progressive

step because the principle applied is a perfect one and the results are uniform and positive.

121 - **Digestibility of Very Young Veal** (1). — LANGWORTHY, C. F. and HOLMES, A. D. in *Journal of Agricultural Research*, Vol. VI, No. 16, pp. 577-588. Washington D. C., July 17, 1916.

The sale of calves aged less than 3 to 6 days is prohibited in the United States by Federal and State laws. Yet in regions where the dairy industry is highly developed, milk is such an important product that it is not thought profitable to rear calves beyond the period when the mother's milk becomes saleable, and so, even though they cannot be marketed as butcher's meat they are often slaughtered at 3 to 6 days old.

The prejudice against young veal is inspired chiefly by a belief that it is indigestible and may cause physiological disturbances. In order to determine how far this belief is founded on fact, various investigators have compared the meat of very young calves with that of more mature calves, both in respect to their chemical composition and their digestibility. On the whole the balance of evidence goes to prove that very young veal is not unsuited to use as human food. As very little information, however, is available as regards the co-efficient of digestibility of very young veal, a series of experiments was undertaken, to determine the completeness of digestion of this material by the human subject in normal health.

Five active young men were selected as the subjects of the experiments. An average of 237 gms. of meat (from calves not more than 5 days old), furnishing 78 gms. of protein or 75 per cent of the total protein of the diet, was eaten daily by each man. The results showed that the digestibility of total protein and that of the meat protein alone were practically identical (92.9 and 92.7 per cent).

The experiments were repeated with the same subjects, but using market veal in the place of the very young veal. The digestibility of the protein in the total diet was again 92.9 while that of the meat was 92.8. In other words very young veal and market veal were found to be equally digestible. No physiological disturbance of any kind were experienced by the subjects either during the experimental period or afterwards.

122 - **Disadvantage of Selling Cotton in the Seed.** — CRESSWELL, C. F. *United States Department of Agriculture, Bulletin* No. 375, pp. 1-18. Washington, D. C. August 9, 1916.

AGRICULTURAL PRODUCTS : PRESERVING, PACKING, TRANSPORT, TRADE

The practice of selling cotton in the seed, though less prevalent than formerly, is still fairly common in the United States. In regions where the crop is not grown in sufficient quantities to attract regular buyers, the producer is thereby enabled to raise cash on his harvest more quickly than he would by the sale of ginned cotton. As a matter of fact, the advantage is a small one and only amounts to the saving of the time he spends in waiting his turn at the gins. Baled cotton being saleable directly to merchants and liable to make the farmer independent of the middleman, ginners do not encourage the sale of ginned cotton, more especially as in

(1) See also *B.* April 1916. No. 455.

buying cotton in the seed, they take into account the speculative nature of the business and generally manage to secure a profit in addition to their regular ginning charge. According to the figures of the Bureau of Crop Estimates 8 to 9 per cent of the total cotton crop in the United States is sold in the seed, while the amounts in Virginia and Missouri rise to 60 and 90 per cent respectively.

In order to obtain reliable information as to the relative advantages of the two methods of marketing, an investigation was carried out in Oklahama during the season 1913-14. Every week a number of samples of seed cotton were collected in representative markets. Each sample weighed 10 lbs. and with it was secured a record of the seller's name, the date, place of sale, and price per 100 lbs. The samples were all sent to Washington where they were ginned and carefully graded.

For the purpose of comparing the returns obtained by marketing the cotton before ginning, with its real value as determined by the ginning, the price paid for seed cotton was converted into its equivalent price per baled lint as follows:

Taking as an illustration a load of seed cotton which was sold at $4 per 100 lbs. and which on being ginned yielded:

30 per cent of lint
68 " " " seed
2 " " " trash

Lint used for bagging and tying at the rate of 22 lbs. per 478 lbs. (rated at the same price as the other lint sold)	=	1.38 lbs.
Therefore total weight of lint sold	=	31.38 lbs.
Value of seed at $ 20 a ton	=	$ 0.68
Therefore payment for lint	=	$ 3.32
Ginning and baling charge at $ 0.070 per 100 lbs.	=	$ 0.22
Therefore total cost to buyer of 31.38 lbs. of lint	=	$ 3.54
Cost of 1 lb. of lint or "equivalent lint price"	=	$ 11.28 cents

By tabulating these "equivalent lint prices", wide variations were found to exist between the prices received for the same quality of lint in the same market and during the same week. This amounted in one instance to as much as 5.21 cents per pound or $26.05 per bale. Moreover it commonly occurred that lint of low quality brought in more money than lint of higher quality.

The fact that the proportion which lint, seed and trash bear to one another varies considerably in different samples and that it is impossible to estimate with any degree of accuracy either the value of these proportions or the quality of the lint before the cotton is ginned makes it impossible to fix a fair price for cotton when sold in the seed. Such a method of marketing is unsatisfactory to both buyer and seller. In some instances the producer will receive more for his crop in the seed than he would in the bale, but in the large majority of cases he loses. Both farmer and ginner are advised for the common good of all to make ginning customary, so that it may be possible to sell each bale on its individual merits.

123 - **Tendency Towards a Levelling of Prices for Fresh and Frozen Meat.** — SAGNIER, H. in *Comptes Rendus des Séances de l'Académie d'Agriculture de France*, Vol. II. No. 16, pp. 477-481. Paris 1916.

The subject of frozen meat has been under discussion at the "Aca- démie d'Agriculture" on previous occasions and a report has been made by ISSERAND on the progress of the industry in England. In the month of ebruary of the present year (1916) the English Board of Agriculture pub- shed the returns for the imports of frozen meat into England during 1915. hese show a considerable rise on those for 1914 owing to the fact that large uantities of meat were reexported to France. Imports of beef rose from 00 000 tons in 1914 to 300 000 in 1915 while the values increased from 8 735 000 to £ 17 798 000 showing a marked upward tendency in prices. o strong is this tendency that the difference in price between fresh and fro- en meat is gradually being eliminated. Frozen beef which sold for 4 $^3/_4 d$ er lb. in 1914 was worth 6 $^1/_2 d$ in 1915 (40 per cent increase) and in the ourse of that year rose to 6 $^3/_4 d$ and reached 7 $^3/_4 d$ per lb. in January 1916; Mutton has passed through much the same changes, though the total ports are smaller than those of beef. Frozen mutton rose from 4 $^3/_4 d$ er lb. in 1914 to 6 $^1/_2 d$ per lb. in 1915 (or an increase of 50 per cent). Frozen utton which came chiefly from Holland made a lower price than the ozen meat, the average price for 1914-15 being 5 $^1/_2 d$ per lb.

PLANT DISEASES

DISEASES NOT DUE TO PARASITES OR OF UNKNOWN ORIGIN.

1124 – **Investigations on the Formation of Cracks in Potato Tubers.** — ZIMMERMAN H., in *Zeitschrift für Pflanzenkrankheiten*, Vol. 26, Fasc. 5, pp. 280-285, Stuttgart, Ju 30, 1916.

In this paper the author gives an account of the investigations carri out during the years 1906-1915 by the section of plant diseases at the Ro tock Agricultural Experimental Station, concerning the formation of i ternal cracks in potato tubers. The results of these very detailed experi ments can be summarised as follows :

The cracks are formed in places where the fields have received too muc nitrogenous manure. Owing to the low degree of starch formation the mid dle tissue of the tuber is poor in starch and transparent in sections. Th central tissue is naturally not rich in starch, and the formation of crack in this region is probably correlated with the lack of starch and is caus by the characteristic growth which is encouraged in the tubers by t exclusive a treatment with nitrogenous manure. The cracks nearly alway begin in the middle of the tuber ; when they extend to the outside, the po tato is rotten inside owing to the inroads of bacteria.

Often the middle of the tuber is discoloured and lumps of tissue a found instead of the cracks. Sometimes also the darkening of the centr region is replaced by a brown zone extending inwards from the point attachment of the stalk and stretching along the vessels, a feature whi is also seen in the potato disease known as " Ringkrankheit ".

The manures that chiefly encourage the appearance of these phenomen are : Chili saltpetre, farmyard manure, and serradilla used as a green m nure. It is stated that up to the present time the disease has only appea in light soils.

According to the author the disease is by origin related to the " Fis (Bunt-) fleckigkeit " and the " Kringerigheit " of tubers. It would be cessary to experiment further before deciding whether metereological co ditions play the same part.

The cracks are not only found in the tubers of potatoes, but also in the ots of mangold-wurzels, swedes and turnips. Probably they also ori- nate from too much nitrogen.

DISEASES DUE TO FUNGI, BACTERIA AND OTHER LOWER PLANTS.

GENERALITIES.

125 - **The Physiological Races of *Erysiphe graminis* on Wheat and Oats.** — REED, M. G., in *University of Missouri, Research Bulletin* No. 23, pp. 1-19. Columbia, Missouri, 1916.

From the results of MARCHAL, SALMON, and the author's works the rphological species *Erysiphe graminis* D. C. ("blanc des céréales") ould be made up of a considerable number of physiological races, of ich each develops on definite hosts and is for the most part connected th only one genus. Thus, for example *Erysiphe* of barley lives on spe- es of the genus *Hordeum*, the *Erysiphe* of wheat on *Triticum*, that of rye, oats, and of meadow-grass, on *Secale*, *Avena*, and *Poa* respectively. metimes it has been possible to note the passage of the parasite from one nus to another of the plant hosts. According to MARCHAL, the *Erysiphe* oats can grow on *Arrhenatherum elatius* and the *Erysiphe* of wheat on *ordeum sylvaticum* and on some species of *Aegilops*. However these ses are rare, for there is even, in nature, a tendency towards still greater ecialization as well as towards physiological adaptation. SALMON's ork follows the same lines, the *Erysiphe* of barley cannot attack all the ecies of *Hordeum*. *H. jubatum*, *H. murinum* and *H. secalinum* are immune. hile *H. bulbosum*, *H. deficiens*, *H. distichon*, *H. hexastichon*, *H. intermeum*, *H. maritimum*, *H. vulgare* and *H. zeocriton* are on the contrary very nsitive. Most of the varieties of *Triticum vulgare* are very susceptible *Erysiphe*, while the three varieties *T. caesium*, *T. ferrugineum* and *T. rothrix* show a high power of resistance. In the present work the re- lts of a long series of experiments are given relative to the physiological ces of *Erysiphe graminis* in the genera *Avena* and *Triticum*. There is thing in the experimental technique that is essentially new, inoculations re made with a scalpel, but also large quantities of conidia were scattered the leaves and stem of plants.

Triticum spp. — The behaviour of 101 species and varieties of *Triti- m* has been studied. It is sufficient in this place to consult the subjoin- table where the relation of the varieties of 8 species or types of *Triticum* *graminis* is shown:

In 101 varieties the infection reaches its maximum, 100 per cent, these varieties that are very susceptible to the attacks of *Erysiphe*. The ht diminution that is seen among the 14 varieties of the second group no specific value. The simple fact that one trial has given a negative ult while in all the others the fungus develops freely cannot certainly interpreted as the beginning of immunity. The same thing can also

Species or type of *Triticum*	Varieties	Percentage infections				
		100	90-99	50-89	10-49	0-9
Triticum compactum	6	2	1	2	1	0
T. dicoccum	24	8	3	6	3	4
T. durum	45	36	0	6	2	1
T. monococcum	6	0	1	3	1	1
T. polonicum	10	9	1	0	0	0
T. Spelta	11	8	1	2	0	0
T. turgidum	7	3	2	2	0	0
T. vulgare	52	35	5	6	3	3
Total	161	101	14	27	10	9

be said about the third group with its 27 varieties, especially in considerin the numerous sources of error (conditions of temperature, moisture, techn que, etc.) which often interfere with the results in this kind of work.

But when, everything else being equal, the results always tend to b negative, and when the percentage of infection falls below 50, it must b admitted that the case is different, and that the variety under examinatio is less susceptible than in those cases where artificial infection is almos always successful. The varieties *Triticum Fuchsii*, "Common Emmer "Russian Emmer", "Spring Emmer", "White Emmer", and "Rhaphi of *T. dicoccum*; the varieties *T. durospermum*, *T. libycum* and "Malaga of *T. durum*; the variety *T. vulgare* of *T. monococcum* and the varieti *T. caesium*, *T. erythrospermum*, *T. ferrugineum*, and *T. pyrothrix* of *T. vulgare*, are undoubtedly all immune to a very great extent.

There are some results of special interest, those which have been obtaine with the wild wheat of Palestine which is considered by many authors t be a distinct species (*T. dicoccoides* Kcke.) and by others as a variety o *T. dicoccum*. This type of wheat should be very susceptible to the attack of *Erysiphe*.

With the exception of several species of the genus *Aegilops* which i moreover often considered as a sub-genus of *Triticum*, all the attempt at infecting grasses of various genera, *Avena sativa*, *Brachypodium dis tachyum*, *Hordeum vulgare*, and *Secale cereale*, have given entirely negativ results.

Avena spp. — 41 varieties belonging to 17 species of oats have bee examined, and, with the exception of *A. bromoides* Gouan. and of *A. sem pervirens* Vill. which show a marked degree of resistance, all the varieti are shown to be very susceptible. The *Erysiphe* of oats can also develo on *Arrhenatherum avenaceum* Beauv. The proportion of infection is h per cent. The parasite cannot however infect barley or wheat.

The author's work gives many experimental proofs of the existenc

d nature of physiological races in *Erysiphe graminis*, and further shows at the degree of susceptibility of the various varieties and species differs nsiderably, for it is possible in a limited number of cases to give rise to perfectly immune condition. In such a case, the inoculation of conidia m the parasite produces no effect, or, at the most, it causes little disco- ured patches to appear on the foliar limbs. In the susceptible varieties e mycelium develops 2 or 3 days after inoculation in obvious patches ich join together often to the extent of covering the leaves and stems th a continuous layer of mycelium; on this layer conidia soon appear in nsiderable quantities.

6 - **Experiments on the Wintering of the Teleutospores of "rust" in Grasses.** — KLEBAHN, H., in *Zeitschrift für Pflanzenkrankheiten*, Vol 26, Fasc. 5, pp pp 272-277, Stuttgart, July 30, 1916.

These experiments were carried out to determine if the teleutospores ain the power of germinating after wintering in the earth. To this l, haulms of *Agropyrum repens* Beauv. and leaves of *Phragmites communis* re kept in pots, the plants having been attacked by *Puccinia graminis* s, and *P. Phragmitis* respectively. The pots were partly filled with d and partly with garden earth, and were kept through the winter in open. Teleutospores were also kept in a pot without a covering of for comparison.

On March 30 the cultures of teleutospores were raised and dried. In control made about April 15 the teleutospores kept under soil or sand germinated better than those kept in the air. The cultures raised April 30 germinated equally well (May 8). The pots were left in the n until the end of April, then they were placed in the glass-house, but out watering. On May 25 when other cultures were taken up, the of the pot was still damp; in *P. graminis* the power of germination good, in *P. Phragmitis* it had suffered a little.

In conclusion, the teleutospores of "rust" in grasses, that have been tered in the earth, germinate in the following spring at least as well hose that have been exposed to the air. From which it follows that, ractice, the haulms of attacked cereals after wintering in the earth, he next spring can reinfect the host of the aecides though not the ce- itself.

- **Breeding Experiments with a View to Obtaining a *Helianthus* Resistant to "rust" (*Puccinia Helianthi*).** — See number 1072 of this *Bulletin*. RESISTANT PLANTS.

- **Mildew of Cereals (*Sclerospora macrospora*) in Spain** (1). — ARROPHELES, *El Cultivador Moderno*, Vol. VI, No. 4, 1 fig. pp. 4, Barcelona, 1916. DISEASES OF VARIOUS CROPS

In the province of Huesca (Aragon), the wheat harvest of 1915 suffered ss of at least 40 per cent. This loss has been attributed to an attack mildew".

The parasite has not so far been recorded on rice in Spain.

1) See *B.* Oct. 1915, No. 1096 and *B.* Dec. 1915, No. 1346.

1129 – **Effect of Certain Species of *Fusarium* on the Composition of the Potato Tuber.** — HAWKINS, L. A. in the *Journal of Agricultural Research*, Vol. VI, No. 5, pp. 183-196. Washington, D. C., 1916.

Potato tubers are subject to the attacks of various parasitic fungi. Some of these invade the tuber, kill the cells, break down the cell walls, and cause, directly or indirectly, a more or less complete disorganisation of the host tissues. In the present paper the writer has given the result of a series of researches on the modifications that are produced in the potato by *Fusarium coeruleum* (Lib.) Sacc., *F. oxysporum* Schlecht and *F. radicicola* Wollenw. Each tuber is cut in four and each quarter is placed in a culture tube stoppered with sterile cotton wool. Of the four preparations, two act as control. This method gives results which are much more directly comparable than those that would be obtained if different tubers were used rather than parts of the same tuber, because the amount of sugar, starch and pentosan contained varies very much in different tubers. The most important conclusions can be summarised as follows:

TABLE I. — *Reducing Sugar and Sucrose Content of the Sound and Rotted Quarters of Potatoes. Expressed as percentages of the original wet weight*

Sp. of *Fusarium* and potato number	Reducing sugar		Sucrose	
	rotted quarter	sound quarter	rotted quarter	sound quarter
Fusarium oxysporum . . 160	0.04	0.31	0.10	0.66
» 159	0.04	0.28	0	0.67
» 158	0	0.44	0	1.03
F. coeruleum 149	0.13	0.40	0.12	0.39
» 150	0.04	0.47	0.24	0.50
» 151	0.17	0.37	0	0.66
F. radicicola 32	0	0.03	0.04	0.24
» 26	0	0.02	0.04	0.19
» 34	0	0.03	0.02	0.09
» 41	0	0.02	0	0.42

As is seen in the table all three species of *Fusarium* use the sugars which in most cases disappear almost completely. The fungi secrete two enzymes sucrase and maltase, which hydrolized the saccarose and maltose. The effect of the fungi on the starch is in marked contrast to their action on the sugars. The amount of starch is undiminished, and there may even appear to be an increase due to the fact that the fungi build up material in the course of the examination. *Fusarium* consumes a considerable quantity of pentosans while leaving the methylpentosans untouched.

TABLE II. — *Pentosan and Methyl- Pentosan Content of Sound and Rotted Quarters of Potatoes (percentage of pentosans, wet weight).*

Potato number	Sound quarter			Rotted quarter		
	Total pentosans	Pentosans	Methyl pentosans	Total pentosans	Pentosans	Methyl pentosans
oxysporum 29	0.53	0.47	0.06	0.50	0.35	0.15
» 30	0.53	0.41	0.12	0.46	0.35	0.11
» 35	0.45	0.36	0.09	0.44	0.35	0.09
» 40	0.52	0.42	0.10	0.37	0.26	0.11
adicicola 171	0.28	0.23	0.05	0.25	0.20	0.05
» 174	0.37	0.32	0.05	0.29	0.24	0.05
» 176	0.25	0.19	0.06	0.26	0.21	0.05

It should be noticed, on the other band, that the fungi grown in potato ract produce as much pentosan as methylpentosan, so that the given ntities in the table represent the difference between the amount of pen- in destroyed and the amount built up by the fungi.

The crude fibre is a mixture of compounds, among which are some of cell wall constituents, including cellulose. The distribution of the crude e is not as uniform as that of the pentosans. It is 3 1/2 to 5 times as ndant in the cortex as it is in the inner part of the tuber. Parasitic ji raise the percentage of crude fibre a little, although the differences in ition are always small.

The substances which give mucic acid when boiled with the proper entration of nitric acid are considered in this paper as galactans. The t of *Fusarium* on these substances is shown in the following table:

LE III. — *Galactan Content of Sound and Rotted Quarters of Potatoes.*

Rotted with *Fusarium radicicola*			Rotted with *Fusarium oxysporum*		
' number	Rotted quarter	Sound quarter	Potato number	Rotted quarter	Sound quarter
27	0.039	0.062	166	0.069	0.071
31	0.033	0.060	167	0.068	0.076
42	0.029	0.030	172	0.081	0.083

All the species of *Fusarium* examined gave practically the same results. worthy of note that the grains of starch remain intact, while the saccharids and disaccharids are attacked by the fungi, although they

form a diastase which readily hydrolizes starch when it occurs in a gelatinous condition.

1130 – ***Fusarium radicicola*, the Cause of Rot in Potato Tubers in the United States.** – PRATT, O. A., in *The Journal of Agricultural Research*, Vol. VI, No. pp. 297-309, Pl. XXXIV-XXXVII, Washington, D. C., 1916.

Fusarium radicicola Wollenw. gives rise to two distinct types of rot in potatoes: a dry rot and a soft or gelatinous rot.

Dry rot (" black rot ") is characterised by blackening of the attacked tissues, which in time always acquire a dark sepia-brown colour. The fungus invades the host by three channels: 1) the point of the branch where the swelling of the tuber begins (" stem-end "); 2) lenticels; 3) eyes. In the first case the parasite develops and extends throught the vascular system which turns black and dies, in the second case it spreads more or less completely round the tissues; finally, in the third case, it passes up the secondary vascular branches but scarcely ever reaches the central axis.

Externally, infected tubers have a sunken brownish-black region. The type of rot is, especially noticeable in potatoes with round tubers such " Idaho Rural " and " Pearl ". In every case where infected material was isolated, *F. radicicola* and sometimes *F. oxysporum* as well were found. The latter should be considered as an occasional parasite, which gets in the tubers by the necrosed vascular bundles. When the spores of *F. radicicola* were injected into the tubers and stolons of the potato the results obtained were definitely positive; after longer or shorter periods of time which vary according to thermal conditions, the characteristic symptoms of " black rot " appeared.

In cases of soft rot (" jelly-end "), the fungus enters the tuber at the point of its formation and the infection spreads inwards; although it spreads more quickly along the vascular bundles, it effects all the tissues to some extent. It is not long before the diseased parts become brown. This type of rot is found principally in potatoes with oval tubers, the Burbank group for example " Netted Gem ". There is no doubt, judging from the positive results of inoculations, that *F. radicicola* is able to produce jelly-end rot. But in isolating the pathogenic germs from naturally infected material could be proved in almost all cases that, in addition to *F. radicicola*, there were also present other species of *Fusarium* such as *F. trichothecioides* and *F. oxysporum*. The last, as shown by CARPENTER'S researchs, can give rise to a soft form of rot in tubers, and considering its almost constant association with *F. radiciola* in jelly-end rot, the author is inclined to believe that it is one of the factors in causing this disease. When tubers infected with " black rot " are sown the crop obtained is to a large extent contaminated, while sowing tubers infected with " jelly-end " rot does not seem to entail harmful results.

F. radicicola is widely distributed in Europe and in America. In the United States it has ben reported from the following states: Idaho, Oregon, California, Nevada, Mississippi, New York, Virginia, and the district of Columbia. It is probably well distributed throughout the desert soils where the damage caused to the potato crop by this parasite can attain

Percentage of Disease in Harvested Potatoes.

Variety	Condition of seed	Percentage of disease in tubers	
		Vascular infection	Tuber-rots
ıho Rural	Infected with blackrot . . .	96	82
arl.	do.	44	40
etted Gem	Infected with jelly-end rot .	16	0
ıho Rural	Disease free, disinfected . .	40	0
arl.	do.	14	1
etted Gem.	do.	10	0

rmous proportions ; in fact anything up to 80 per cent of the tubers may ıttacked. On the other hand, in a fertile and well irrigated soil, previ- ly planted with grain or leguminous crops, the conditions are unfavoura- to the forms of rot mentioned above, and the percentage of infected tu- s is always very low.

Control of blackrot : 1) precede potatoes by a crop of lucerne or of er plants which can improve the soil ; 2) maintain the lowest possible ıperature in all storage places.

1 - ***Phytophthora* sp., as the Cause of Black Thread Disease of *Hevea brasiliensis* in Burma.** — DASTUR, I. F., in *Department of Agriculture, Burma, Bulletin* 14, pp. 1-4, 1 plate, Rangoon, 1916.

In *Hevea brasiliensis* black vertical grooves appear on those parts of the nk that have been laid bare by tapping ; these sink into the wood through : cambium. The infected parts crack and the latex oozes out and some ies accumulates between the wood and the new cortical tissue that is being med. The latter withers and comes off leaving a deep wound or canker the uncovered woody tissue.

In this way the cambium can be absolutely destroyed. The destruction alterations in the cambium put a stop to the ordinary renewal of the ex, but there is an abundant proliferation of callous tissue, and the sur- : of the trunk which has become gnarled and irregular is not suitable new incisions. In sections of the diseased tissue the cells are swollen hout protoplasmic content, and filled with a yellow-brown gummy stance.

The constant presence of intercellular, non septate hyphae at once sug- ts the existence of a species of *Phytophthora*, especially, when in addition the disease of the trunk, a characteristic alteration is observed in the fs, accompanied by an exudation of latex undoubtedly caused by a *tophthora*.

Cultures obtained from diseased fruits and inoculated into the stems *'evea* give rise to pathological symptoms identical with those described. Drought and light are important factors in checking the develop- t of the fungus, which requires moisture. The disease appears soon

after the rains break out and completely disappears after the close of the monsoon with the return of the dry and sunny weather.

The damage caused by " Black thread " is very serious; in 1915 in a plantation of 77 000 trees in Burma, tapping was prevented in 12 000, the loss of rubber being estimated at two to three thousand pounds.

Treatment: 1) the fungus fructifies very poorly on the stem but very profusely on the fruits which should be considered as the principal source of infection; infected fruits should therefore be collected and destroyed when they first appear; 2) pruning should be freely indulged in, so that penetration of sunlight and free circulation of air are ensured; 3) tapping should be stopped and the tapping cuts treated with a 20 per cent solution of carbolineum every five days.

1132 – ***Corticium salmonicolor*** **(" pink disease") of Cacao, in the Island of Trinidad, Antilles** (1). — RORER, J. B., in *Bulletin of the Department of Agriculture, Trinidad and Tobago*, Vol. XV, Part 3, pp. 86-89, 1 pl., Port-d'Espagne, 1916.

At rare intervals during the past seven years the cacao disease known as "pink disease" has been recorded on several plantations in the northern and eastern parts of Trinidad. The disease receives its name from the fact that the attacked branches, especially on the lower or shaded side, are covered with a pink incrustation which is the fruiting stage of the fungus that causes the disease, *Corticium salmonicolor* Berk. and Br. (and not *C. lilacino-fuscum* Berk. and Curt. as was formerly believed).

Up to the present time the fungus is not a really serious menace to cacao cultivation in the West Indies.

It can live at the expense of great many plant hosts and so has caused considerable damage elsewhere; for example, to *Hevea* in the United States to coffee in Java, etc.

In the case of cacao the small branches are most often attacked and are rapidly killed; if the fungus in the course of its rapid development reaches the larger branches the whole crown of the tree may become infected. The leaves on the diseased branches wither, turn brown and fall to the ground.

Where the disease occurs sporadically the infected branches should be cut out and burnt immediately. If the diseased parts have to be carried out of the plantations they should be put in bags to prevent the dispersal of the spores of the parasite. If the disease should assume serious proportions Bordeaux mixture or other fungicides could be usefully employed. This is a simple matter in cacao plantations or in rubber plantations where the plants are two or three years old.

In cases of serious attack in old rubber plantations spraying is not recommended on account of the almost insurmountable difficulties met with in treating large trees. The disease is more effectively dealt with by cutting out and burning the affected parts, where this is possible, or where only a limited number of trees are attacked. If the infection is wide spread good results have been obtained by treating the diseased parts with tar as soon as

(1) See also Bulletin Sept. 1913, No. 1107, and Bulletin Feb. 1915, No. 135. [illegible]

the first symptoms appear. In Trinidad the disease has never so far been discovered on rubber, but now that this plant, is fairly widely cultivated there and in some cases among cacao trees, the surrounding cacao should be carefully watched, so that in case the fungus should appear precautions could be promptly taken to prevent its spreading to the rubber.

1133 - ***Phoma Lavandulae*** **on Lavender (*Lavandula officinalis*) in England.** — BRIERLY, W. B., in *Bulletin of Miscellaneous Information, Royal Botanic Gardens, Kew*, No. 5, p. 113-131, Figs. 1-9, Pl. V-VI, 1916.

Phoma lavandulae Gab. was recorded for the first time in England in 1915. It is the cause of a serious disease in *Lavandula officinalis*. The diseased buds and shoots are brown in colour, the leaves wither and fall, and the epidermis splits away in minute silvery flakes. The infection spreads very quickly from one plant to another so that it readily attacks and destroys whole beds.

In pure cultures the fungus produces pycnospores and conidia, which are hyaline with thin walls (which later on become brown while the walls thicken), and characteristic brown chlamidospores, with very thick walls. The thin walled spores germinate quickly; they are not very resistant to drought and are killed by frost. The thick walled spores on the other hand are very resistant and only germinate after a resting period.

Inoculation experiments gave positive results, and confirmed the pathogenic properties of the fungus which is very probably confined to the genus *Lavandula*. The mycelium branches freely through the host tissues, causing disintegration of the peridermis and phloem. It also penetrates into the xylem and the hyphae often reach the inside of the cells through the pits in the walls. The pycnidia are formed immediately below the epidermis which splits away from the cortex. The optimum temperature for the growth of the mycelium is about 18° to 20° C.

To check the infection the diseased shoots should be cut out and es- roved as soon as they appear.

1134 - ***Fusarium*** **sp. ("die-back disease") a Pest on *Hibiscus* in the Federated Malay States.** — SHARPLES, A., in *The Agricultural Bulletin of the Federated Malay States*, Vol. VI, No. 7, pp. 217-218, Singapore, 1916.

Several species of *Hibiscus* which are cultivated in the Federated Ma- y States for ornamental purposes are attacked by a fungus that kills the oots. The disease, whose common name is " die-back disease ", develops incipally in hedges of *H. Rosa-sinensis* which are periodically pruned. The oots blacken and die from the top onwards, the leaves wither and fall, id finally the plant is reduced to a cluster of dead branches. The author as been able to isolate from infected material two fungi in pure cultures *olletotrichum* sp. and *Fusarium* sp.). Inoculation experiments showed that *usarium* sp. is the specific cause of the disease described above. The my- elium of the parasite penetrates the host by means of the numerous lesions nd cuts which result from pruning. It is therefore suggested that this oper- tion should always be followed by an immediate dressing with Bordeaux ixture.

WEEDS AND PARASITIC FLOWERING PLANTS.

1135 – ***Razoumofskya* spp. Mistletoes Injurious to Conifers in the United States** – WEIR, J. R., in *United States Department of Agriculture, Bulletin* No. 360, pp. 1-39, Fig 1-17. Washington, D. C., 1916.

It is not generally known that the injury caused by several species of *Razoumofskya* (*Arceuthobium*) to coniferous trees in certain localities of the north western United States has attained to such proportions that the question has assumed all the characters of a serious forest problem. The species which suffer the most are: Western Larch (*Larix occidentalis*), Western Yellow Pine (*Pinus ponderosa*), Lodgepole pine (*P. contorta*), and Douglas Fir (*Pseudotsuga taxifolia*). Each of these hosts in attacked by a distinct species of *Razoumofskya*: *R. laricis* Piper; *R. campylopoda* (Engelm.) Piper; *R. americana* (Nutt.) Kuntze; *R. Douglasii* (Engelm.) Kuntze.

The most striking symptom of the disease is the gradual reduction of the leaf surface, caused by the " witch's brooms " and by various outgrowths which occur on the trunk and branches, and which in time can cause the death of the host. In all the cases the development of the tree is seriously retarded, as is shown in the following table:

Host and condition	Basis (number of trees)	Average			
		Age class	Height	Diameter breast high	Total annual growth
		years	feet	in.	in.
Pinus contorta					
Infected	50	65	35.2	6.3	0.93
Uninfected	50	60	48.5	7.8	2.93
P. ponderosa					
Infected	50	100	49.5	18.2	1.54
Uninfected	50	100	77.2	22.2	5.33
Larix occidentalis					
Infected	80	144	63.0	11.5	1.28
Uninfected	80	144	115.0	19.5	2.154
Pseudotsuga taxifolia					
Infected	40	97	62.0	17.3	2.175
Uninfected	40	97	73.0	22.2	3.28

One of the first effects of infection, either of branch or of trunk, is the formation of a fusiform swelling, which is sometimes very pronounced and resembles the enlargements caused by some species of *Peridermium*. On the branches this swelling is the first stage in the development of a

" witch's broom " which grows slowly and attains to enormous proportions. The habit and appearance of the tree is entirely altered. Often under the stress of snow and wind the " brooms " split and fall to the ground, where, piled round the foot of the tree, they constitute a serious danger in case of ground fires.

On the trunk the presence of *Razoumofskya* leads to the formation of burls. When the infection occurs at the base of a branch and then travels towards the main trunk the result is a " broom " which later dries up and falls, leaving in its place a burl which is more or less scarred. If, on the contrary, infection occurs directly on the main trunk, the beginning of a burl is at once formed, and this radiates outwards and becomes fan-shaped keeping time with the growth of the tree. Finally the central part of the swelling disintegrates leaving a wide opening more or less deep. This is a convenient entrance for boring insects and for numbers of fungi, which find the decomposing tissues an excellent substratum : *Trametes Pini* (Brot.) Fr., *T. serialis* Fr., *P. volvatus* PR., *Fomes Laricis* (Jacq.) Murr., *F. pinicola* Fr., *Stereum sulcatum* Burt., *Polyporus sulphureus* Fr., *Lenzites sepiaria* Fr., *Coniciun Berkeleyi* Cooke, *C. galactinum* (FR.) Burt., *Peniophora subsulphurea* (Karst) Burt, *Ceratostomella pilifera* (Fr.) Wint., and, less often, *Pholiota adiposa* DFr., and *Echinodotium tinctorium*.

The following means of suppressing *Razoumofskya* are suggested ;

1) to fell and remove all badly infected trees, which may or may not be a useful measure ;

2) strict control of nurseries and supervision of plants coming from infected areas ;

3) to plant conifers closely, and eventually to associate them with other species such as yews and junipers which will shut out the light, as shade discourages the development of mistletoe.

130 - ***Asphodelus fistulosus* and *Stachys arvensis*, Harmful Weeds in New South Wales.** — MAIDEN, J. H., in *The Agricultural Gazette of New South Wales*, Vol. XXVII, Part. 5, pp. 335-338, 2 Pl., Sydney, 1916.

A description of *Asphodelus fistulosus* L. (" onion weed ") and of the allied *Stachys arvensis* (" stagger weed ").

In Australia the first of these weeds is known not only in New South Wales but also in central Australia (where it is common), in Victoria and in Western Australia ; it has not yet been recorded from Queensland. It tends to overrun the ground wherever it manages to establish itself, and no animal appears to feed on it except by accident. Burning it before the flowering season, if possible entirely, is the best method of suppressing this weed.

S. arvensis is common in central Australia, in New South Wales, in Queensland and in Victoria ; in New South Wales it is especially frequent, and is reported as causing serious trouble among cattle. As it thrives best in damp places it is advisable to improve the drainage of pasture lands to discourage the development of useful plants.

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(1) See also *B.* Dec. 1913, No 1403, and *B.* Feb. 1914, No. 187. (*Ed.*).

INJURIOUS INSECTS AND OTHER LOWER ANIMALS.

GENERALITIES. 1137 - **Insect Pests in India.** — FLETCHER, T. B., in *Agricultural Research Institute, Pusa, Bulletin* No. 59, pp. 1-36, Fig. 1-20, Calcutta, 1916.

The work in question contains one hundred short notices on Indian insect pests.

The following observations, dealing for the most part with agriculture, are worthy of special notice.

Among the Coleoptera, *Adoretus lasiopygus* (fam *Rutelidae*) is a very common species in the Pusa district, where it causes considerable damage to the leaves of plants between June and September; at Begum Serai it attacked vines stripping off the leaves and injuring the fresh shoots.

A. versutus is also very common in numerous Indian localities; it was reported in June 1910 and 1912 from the Kumaon gardens as a pest on the leaves of vines, pears, plums, apples, and figs, which it attacked in association with *A. horticola* Arrow and *Brahmina coriacea* Hope. Similar damage is caused by another species of *Adoretus* (*A. duvauceli* Bl.).

Numerous Coleoptera belonging to the family *Curculionidae* inflict more or less extensive injuries upon cultivated plants. There are *Phytoscaphus dissimilis* and *Corigetus bidentulus* on tea in Assam and Upper Burma; *Rhynchaenus* (*Orchestes*) *magniferae* (mango leaf boring weevil), *Cryptorhyncus-poricollis* and *Alcides frenatus* on mango trees; *Xanthotrachelus faunus* and *X. perlatus* which attack the heads of *Helianthus annuus*; *Calandra linearis* on the fruits of tamarinds and *Myocalandra exarata* on bamboos.

In July 1915 *Lytta actaeon* (Family *Meloidae*) attacked the fields of *Setaria* in the region of the Chota Gandak River in great numbers, completely devouring the leaves.

Among the Lepidoptera, *Calpe ophideroides* caused great damage to fruit in 1914 in the Kumaon Government, especially to peaches and nectarines

The larval stage of *Argyroploce erotias* (Family *Eucosmidae*) caused considerable damage to the foliage of mangoes by rolling up the leaves and biting holes in them.

Laspeyresia trichocrossa, which belongs to the same family, in its larval stage bores its way into the pods of *Cajanus indicus* and there pupates, having destroyed the seeds.

In March 1912 at Pusa the larvae of *Anarsia melanoplecta* were seen to hollow out tunnels in the top shoots of mango twigs.

Anataractis plumigera formed galls on the stems of *Indigofera* in which the larvae underwent their first developmental stages.

The larvae of *Acrocerops syngramma*, *A. cathedra* and *A. isonoma* attacked the leaves of mangoes (mango leaf-miners). The caterpillar of *A. ordinatella* feeds in the parenchyma of the leaves of camphor leaving the epidermis intact.

Prays citri (Family *Hyponomeutidae*) is found in southern Europe,

in New South Wales (Australia), in the Philippines, in India (North Coorg,) and in Ceylon (Colombo, Maskeliya and Mandulsima). In southern Europe the larvae eat into the flowers and the shoots. In the Phillippines they bore into the rinds of Citrus fruits making a gall, so that the fruits may be seriously damaged. It is quite possible that this insect will soon become a pest in India and Ceylon, where at present its interest is purely entomological.

1138 – **The Caterpillars of the Goat Moth (*Cossus cossus*) and the Codling Moth (*Carpocapsa pomonella*) and their Powers of Resistance to Cold.** — GUERLARD, F. P., in *Comptes Rendus des Séances de la Société de Biologie*, Vol. LXXIX, No. 15, pp. 771-777, Paris, July 29, 1916.

Experiments show that the caterpillar of *Cossus cossus* can resist freezing of all its organs and tissues. The caterpillar does not appear to suffer even if it is frozen any number of times. A quick transition from a temperature of -15° C. to one of 30° C. does not cause death and does not apparently change the tissues. This resistance results from an adaptation which only occurs in nature during the cold season. It disappears completely during the hot heather.

The caterpillar of *Carpocapsa pomonella* apparently reacts to cold in exactly the same way as that of *Cossus*. This remarkable resistance to cold does not seem to be very wide spread among the invertebrates. It is even far from occuring in the xylophagus larvae.

These differences seem to be correlated with certain peculiarities in the mode of life of these larvae.

MEANS OF PREVENTION AND CONTROL

1139 – **Observations on the Insect Parasites of Some Coccidae.** — IMMS, A. D., in *The Quarterly Journal of Microscopical Science*, Vol. 61, Part. 3, pp. 217-274, 5 Figs. 2 Pl. London, 1916

This is the first of a series of papers dealing with the biology of the principal insect parasites of certain *Coccidae*, with a view to determine the importance of these parasites in their relation to a family whose economic importance is very considerable. That certain of the *Coccidae* are extensively parasitised is well known, but up to the present time, little has been known of the effects of this parasitism. At the same time these cannot be understood until the essential characters of the relation between host and parasite are fully known. The present paper treats of *Aphelinus mytilaspis* Le Baron, one of the chief parasites of the "mussel" scale (*Lepidosaphes ulmi* L.).

The paper contains a very complete bibliography, and clear illustrations.

L. ulmi is the commonest of the injurious *Coccidae* found in the British Isles. Its favourite food-plant is the apple, but QUAINTANCE and SASSCER record over 118 host plants. It has been stated that the females begin to lay their eggs on or about August 17, and that they continue oviposition on into September. By the end of October almost all the parents are dead and their scales protect the eggs. The newly hatched larvae appeared on May 21 in the following year, and the developmental cycle is completed by

the end of July or the beginning of August. In Great Britain the insect is single brooded, but in certain regions of North America there are two broods.

The number of eggs laid varies a good deal. In America apparently the average number does not exceed 80, while in England the average is about 37,2 eggs per female.

The genus *Aphelinus* is placed among the parasitic Hymenoptera and belongs to the sub-family *Aphelininae*. This sub-family is very widely distributed, species being known from almost all parts of the globe, with the exception of the colder temperate and polar regions. A list of the localities in England in which it occurs is given in this paper.

The larvae of the *Aphelinae* are either exclusively parasitic or parasitic and partially predaceous. They confine their attacks almost exclusively to the *Rhynchota*, the *Coccidae* and the *Aphididae* being their principal hosts.

Several hosts are mentioned as being subject to the attacks of this parasite in various regions. The author gives detailed descriptions of diverse stages in the two sexes, of parthenogenesis, of oogenesis, and of the external and internal morphology. Experiments in breeding have been successfully carried out in the Manchester University Biological Experiment Ground, in specially constructed breeding cages, with a view to investigating the biology of the parasite.

The life history of the parasite can be summarised as follows: in one year it passes through two generations, and the adults are almost, always females. Out of 750 individuals reared only 10 were males, about 1 per cent. Reproduction takes place almost entirely by means of parthenogenesis. The adults very rarely fly, and have extremely limited powers of migration. In the first generation the adults appear in greatest frequency between the third week in June and the middle of July. The female lays a single egg on the dorsal or ventral surface of the body of the immature host, only the scaly covering of the latter being perforated. The newly hatched larva closely resembles the fully grown stage in form, and during larval life the insect is an ectoparasite of its host. The second generation of adults mostly appear between the middle of August and the first week in September. They parasitise the sexually mature hosts, and the resulting larvae hibernate through the winter, giving rise to the first generation of adults of the following year. The results of the first generation of parasitism are complete, the affected hosts invariably dying in consequence. In the second generation of parasitsm the affected hosts usually deposit a small number of eggs before succumbing; its results, therefore, are partial and incomplete. The parasite exercises an inhibitory effect upon oviposition, the essential reduction in the number of eggs not being primarily due, as stated by previous observers, to their destruction by the *Aphelinus* larvae. Assuming that every 100 hosts lay on an average 37 200 eggs, the net results of a year's parasitism entails a reduction of about 2600 in the number of eggs laid, or 7 per cent. The efficiency of the parasite, therefore, is far below that of the most effective insecticides. This is primarily due to four factors: 1) the

extremely limited powers of migration; 2) its relatively low fecundity; 3) its marked susceptibility to the influence of unfavourable climatic conditions; 4) the effects of the second annual generation of parasitism being only partial and incomplete.

140 - ***Aphicus hesperidum*** **n. sp., an Ectophagous Parasite on the Cochineal of Citrus Fruits *Chrysomphalus dictyospermi* in Spain** (1). — MERCET, R. G., in *Revista de la Real Academia de Ciencias exactas, físicas, y naturales de Madrid*, Vol. XIV, No. 11, pp. 776-788, Fig. 1-5 Madrid, 1916

A description of the the new Chalcidid *Aphycus hesperidum*, an ectophagous parasite of the cochineal insect discovered by the writer on orange trees (at Seville, Huelva, Valencia and Palma in Mallorca), on laurels (at Palma in Mallorca) and on oleanders (at Seville) which had been attacked by this cochineal.

The female of this Chalcidid lays her eggs under the silpha of the host, which later on is devoured by the larva after it has been hatched.

Among the natural enemies of *Chrys. dictyospermi* (2), the writer particularly mentions *Aphelinus chrysomphali*, which he has described in an earlier paper, *Prospaltella lounsburyi* and *Chilocorus bipustulatus*.

1141 - ***Hyperaspis binotata*****, a Coccinellid Beetle Predatory on *Eulecanium nigrofasciatum* (terrapin scale)** — SIMANTON, F. L., in the *Journal of Agricultural Research*, Vol. V, No. 5, pp. 197-203, 1 Fig., Pl. XXIV-XXV. Washington, D.C. 1916.

During a good season the adults of *Hyperaspis binotata* Say destroy great quantities of *Eulecanium nigrofasciatum* Pergande. They hibernate in the bark and in the vegetable refuse at the foot of peach trees infested by terrapin scale. They emerge towards the end of April (at Mount Alto, Va.) Mating takes place in the spring and oviposition continues until the beginning of September.

The larvae not only devour the young of the scale but also the adults. It is estimated that a single larva of *Hyperaspis* is able to destroy 90 mature scales and 3000 larvae of *Eulecanium*.

H. binotata is common in the whole of the territory east of the Mississippi, and extends west of this river in some states to the semi-desert region. It is most abundant on the Atlantic side, from Connecticut to Maryland.

142 - ***Holcocera iceryaeella*****, a Lepidopteran that Destroys Cochineal Insects in California.** — ESSIG, E. O., in *Journal of Economic Entomology*, Vol. 9, No. 3, pp. 369-370, Pl. 28. Concord, 1916.

During the summer of 1915 the author undertook a series of researches and observations on *Holcocera iceryaeella* (Riley) (*Blastobasis iceryaecella* Riley), a Lepidopteran which destroys cochineal insects, and which occurs in great numbers on the experimental farm of the University of California. It is not easy to establish exactly the way in which this insect is nourished

(1) See *B.* February 1913, p. 170; and *B.* June 1913, No. 705.

(2) See *B.* April 1915, No. 451; *B.* Oct. 1915, No. 1102; *B.* July 1916, No. 827; *B.* August 1916, No. 948. (*Ed.*).

and in what proportion the dead and living cochineal insects occur in its food.

Among its hosts, in addition to *Saissetia oleae* Bern (black scale) and *Icerya purchasi* Mask. (Cottony cushion scale or fluted scale) which are already known, the author cites *Lecanium persicae* Fab. (European peach scale), *Aspidiotus camelliae* Sign. (greedy scale) and *Pseudococcus bakeri* Essig (Baker's mealy bug).

The *Holcocera* larvae weave large nets on the branches of the plants, and without leaving these, they feed upon the eggs and the young individuals of the cochineal insects which pass the entrances, but the adults are never attacked.

1143 – **Birds in the Vineyards in the Region of Nîmes.** — HUGUES, A, in *Comptes rendus des séances de l'Académie d'Agriculture de France*, Vol. II, No. 17, pp. 504-508. Paris 1916.

The birds which live in vineyards in the region of Nîmes are passed in review; these birds feed upon insects and do not attack the grapes; they thus are worthy of efficient protection. The author cites in particular the ortolan (*Emberiza hortulana*), the stonechat (*Pratincola rubicola*) the wheatear (*Saxicola oenanthe*), the European bunting (*Miliaria europaea*) the crested lark (*Galerida cristata*), the short toed lark (*Alauda brachydactyla*), the common linnet (*Cannabina linota*), and the warblers. The tomtit (*Parus major*) is recorded as being especially efficient; it attacks the woolly bear caterpillars of the tiger moth (*Arctia* or *Chelonia caja* L.) and those of *Cuculus canorus*. The European night-jar (*Caprimulgus europeus*) destroys butterflies.

Red partridges (*Perdrix rubra*) and magpies (*Pica caudata*) eat the grapes but most often the damage is done to the bordering plants. In this district in a good year about 659 625 gallons of wine are gathered in, and the losses caused by these two birds do not exceed 27 000 gallons. Fieldfares arrive in October and eat the grapes left by the grape gatherers and the gleaners, grapes which are in any case lost to the vine grower. The golden oriole (*Oriolus galbula*) and the sparrow (*Passer domesticus*) have not caused any complaints. In conclusion, in the vineyards of lower Provence there is not a single bird that is really harmful while there are a great many that are of use.

INSECTS INJURIOUS TO VARIOUS CROPS

1144 – **The Thermites (*Leucotermes* spp.) Harmful to Agriculture in the United States.** SNYDER, T. E., in *United States Department of Agriculture, Bulletin* No. 353 pp. 1-32. Fig. 1-5. Pl. I-XV. Washington, D. C. 1916.

The three best-known species of termites (white ants) in the United States are: *Leucotermes flavipes* Kollar, distributed over the whole of North America, from the Pacific to the Atlantic, and from Canada to the Gulf of Mexico; *L. lucifugus* Rossi, common in Texas, Arizona, Kansas, Colorado and South California, and *L. virginicus* Banks, indigenous to Maryland and Virginia (including the district of Colombia). They cause considerable damage to the principal plants cultivated, apart from wood and other materials (e. g. paper, books).

These insects attack the stem of the cotton plant at a depth of about

3 inches below the soil and penetrate into it boring tunnels of varying dimensions; they cut into and gnaw all the tissues to such an extent that the aerial parts of the plant often wither and die. In June and July 1910 observations were made at Lampasas, Granbury, Pearsall, Plano in Texas.

Termites also make furrows and bore holes in the surface of potato tbers, but, according to MARLATT, they confine their attacks to potatoes nfected with "gale".

Considerable damage to maize has often been recorded in North Calina, Kansas, Tennessee and Alabama. The termite workers penetrate nto the stem and only leave a thin superficial layer intact. In their work f destruction the termites generally make use of galleries bored by other nsects (*Diatraea saccharalis* Fab. and *Sphenophorus maidis* Chittn.); hey confine themselves to enlarging and completing these galleries, hich fact does not however exclude the possibility of an attack being dicted against perfectly healthy plants. In August 1908, in the plantaions of Chemson College (South Carolina), 5 per cent of the stems were nfested and each stem contained from 5 to 75 termites.

In the Kansas nurseries in 1909 and 1910, the termites, encouraged y the dry season, attacked the young saplings of apple trees, from to 3 years old, gnawed the bark and caused the death of a great number the trees.

In several localities in the United States, geraniums, rosetrees, jessaine, laurestinus, *Opuntia* and many other ornamental plants in hot nses and the open air alike, often suffered from the attacks of termites. Methods of combating these pests: 1) collect and destroy the prunings branches and all the vegetable debris in which these animals often find itable shelter; 2) in badly infected regions avoid the cultivation of the lants which are most liable to attack for several years and give preferce to grasses; 3) during the operation of ploughing, digging, etc. avoid rrying vegetable debris in which termites can hide; 4) in hot houses d nurseries dispense with animal manures and give the preference to cheical manures; 5) if the plant in question is a vine proceed carefully with uning avoiding serious lesions, and finally cover the scars with coal tar ther substances of a similar nature.

- ***Pulvinaria floccifera* and *Chrysomphalus dictyospermi*, Cochineal Insects Recently Established in California.** — ESSIG, O. in *The Monthly Bulletin State Commission of Horticulture*, Vol. V, No. 5, pp. 193-197, Fig. 65-70. Sacramento al., 1916.

Among the insects imported into California from other countries a cernumber of cochineal insects figure, some of which cause great da- e to kitchen-gardens and orchards.

Pulvinaria floccifera Westwood (Camellia scale) and *Chrysomphalictyospermi* Morgan (Dictyospermum scale) are of very recent impor- on.

Up to the present *P. floccifera* has only been able to establish itself single locality in San Jose. Here we are dealing with a cosmopoliparasite common throughout the temperate zone, and well known in the

eastern and southern regions of Canada and of the United States. Its favourite host as its English name indicates is beyond doubt the *Camellia japonica*; then come *Euonymus* sp., *Oncidium Papilio*, *Calanthe natalensis*, *Anguloa Clowesii*, *Lycaste Skynneri*, *Acalypha* sp., *Brassica verrucosa*, *Phaius maculatus*, *Coffea arabica*, and *Euonymus alatus*.

Chrys. dictyospermi, widely distributed over the tropical and sub-tropical regions, is also met with in the temperate zone, in hot houses and sheltered places. In California this species has been recorded from Ventura, Berkely, Marysville, and San Diego. It is mentioned as attacking *Kentia*, orchids in general, *Coelogyne cristata* and *Persea gratissima*. In other regions this cochineal insect has also been observed on *Dictyospermum album*, *Erythrina indica*, *Cycas* sp. (sago palm), *Latania* sp., on palms in general, on *Mangifera*, *Pandanus graminifolius*, *Areca triandra*, *Cypripedium* sp., *Dendrobium* sp., *Anthurium* sp., *Aloe Zeyheri*, tea plants, *Ficus* sp. etc.

In the Italian peninsula, in Sicily and in Spain, this insect causes serious damage to citrus plants, hence the necessity of careful supervision, so that the parasite may not extend its attacks to this group in California.

1146 – ***Chortophila cilicrura* and *Thereva* sp., Pests on Rye in Silesia, Germany.** — OBERSTEIN, in *Zeitschrift für Pflanzenkrankheiten*, Vol. 26, Fasc. 5, pp. 257-280. Stuttgart July 30, 1916.

In Silesia, during the period of vegetation of 1914 and 1915, it was observed that the winter crops were attacked by a pest which devoured the leaves from the top to the bottom in succession, almost to the foot of the plant. This damage was recorded from a vast extent of land, and although the same caused great damage in these localities, it was certain that it had not done the mischief in question. The parasite also attacked the corn but it did more harm to the rye.

On November 22, 1915 the Experimental Station for Agriculture, Botany of the Chamber of Agriculture of Silesia, received from the district of Glogau, larvae and pupae which came from three fields of rye. According to the peasants the larvae, by eating the grain immediately before and after germination, had caused great damage to the young plants which by degrees died.

After rye, lupins were grown and were also attacked. On December 11, 1915 the Station received a second consignment of pupae—there were more larvae—which were used to identify the insect; at the beginning of February 1916 laboratory breeding experiments gave rise to males and females of a Dipteran which was identified as *Chortophila cilicrura*.

On October 17, 1915 another pest, hitherto unknown, was sent from the district of Steinau a. O. to the Station. The infected rye succeeding sarradilla had hardly germinated. The young plants were gnawed; a great number of white diptrous larvae were found in the soil which were without legs, shaped like wire-worms and with little black heads. A neighbouring field in which the previous crop had been oats was unattacked; the rye had germinated satisfactorily. All the rye examined was treated with

"Uspulun" before the harvest (1). About a month later only a few larvae of different sizes were found. The insect was identified as *Thecla*, but the species is not yet known. As the pest has appeared in great number in other places as well, the writer decided to study it in detail.

1147 – **The Potato Ladybird Beetle (*Epilachna dregei*), a Coleopteran Pest on Potatoes and other Plants in South Africa.** – GUNN, D. in *Union of South Africa, Department of Agriculture, Division of Entomology*, No. 6, pp. 1-7, 1 Pl. Pretoria, 1916.

This insect, which is now spread over the whole of South Africa, attacks countless cultivated and wild plants, being especially injurious to the potato.

On an average, in both the first and the second generations, the life cycle of *Epilachna dregei* occupies 49 days; in the first generation its minimum length is 41 days, and in both the maximum is 57 days. The duration of each period is as follows:

Incubation	7 to 11 days
Larval existence	28 to 36 days
Pupal existence	6 to 10 days

The eggs are laid in little heaps on the under surface of the leaves of the host; when hatched the larvae remain in groups until the first change of skin, after which they spread over the whole plant, eating the foliage. The adults finish this work of destruction, for they leave nothing but the veining intact, so that the plant soon withers and dies. During the summer of 1913, about 18 acres of potatoes were destroyed on a single estate near Johannesburg.

Applications of lead arseniate (about 3 lbs. in 48 gallons of water) are suggested as soon as the larvae appear as a means of prevention.

Besides potatoes, this *Epilachna* also attacks pumpkins, cucumbers, spinach, turnips, radishes, melons, beans and some of the *Solanums* which grow in the gardens and fields.

– **The Clover Leafhopper (*Agallia sanguinolenta*), an Hemipteran Pest on Leguminous Forage Plants in the United States.** – GIBSON, E. H., in *United States Department of Agriculture, Farmer's Bulletin*, No. 737, pp. 7-8, Fig. 1-5. Washington, D. C., 1916.

Agallia sanguinolenta damages the Leguminous plants used for fodder, more especially lucerne and clover, in various ways. Numerous specimens (sometimes as many as 600) collect on a single plant, they pierce the epidermis of the leaf stalk and extract some of the juice from the tissues, so that the most delicate branches wither, and the new shoots which are poorly nourished develop badly. In addition, the females, by laying their eggs at a considerable depth in the peridermis and parenchyma, provoke the formation of galls which check the normal development of the plant.

Preventive measures: 1) during the winter burn the vegetable debris

1) See *B.* August 1916, No. 938. (*Ed.*).

and weeds in the fields, along the roads and in the uncultivated steppes when the insects hibernate ; 2) if the attack is very violent cut the forage earlie to deprive the voracious insect of its favourite food ; 3) catch the insec by means of an ordinary hopperdozer.

1149 – **The Pepper Tree Caterpillar (*Bombycomorpha pallida*), a Lepidopteran Pest on the Pseudo-Pepper Tree (*Schinus Molle*) in the Transvaal.** — DUSER, D in *Union of South Africa, Department of Agriculture, Division of Entomolo y*, No pp 1-10, 1 Pl. Pretoria, 1916.

During the last few summers considerable damage was caused to *Schinus Molle* in Pretoria and the surrounding country by the larvae of *Bombycomorpha pallida* Dist., which feed upon the leaves of this tree. The eggs which are stuck together by a gelatinous substance form a coating round the branches of the plant host 2 or 3 cms. long. The larvae which are all hatched out at the same time have a markedly gregarious tendency, and, having devoured the leaves on which they were born, they prefer to destroy each other, instead of separating and emigrating. Thus cannibalism occurs and brings about the destruction of the smallest and feeblest specimens. Finally, having exhausted all the possible resources, the larvae emigrate in groups of five or six to other parts of the tree and finish stripping off its leaves.

As a means of artificial resistance the following may be used : 1) gathering the branches on which the larvae occur when all of them may easily be destroyed ; 2) applications of lead arseniate (about 3 lbs in 4 gallons of water) ; 3) when the larvae are mature they abandon their host and crawl down to the ground, looking for a suitable place in which to pupate : if pieces of cloth, or other material, are placed round the stem the larvae can easily be caught as they emigrate in great numbers. Thus future infection can be checked.

1150 – ***Pegomyia hyoscyami*, a new Dipteran in the United States Harmful to Spinach and other Plants** (1). — COREY, E. N. in *Journal of Economic Entomology*, Vol. 9, pp. 372-375, Fig. 21. Concord, N. H., 1916.

The appearance of an insect which is new to the United States has just been recorded. It is *Pegomyia hyosciami* Panz. whose larvae bore holes and galleries in the thickness of the leaves of *Spinacia oleracea*, *Chenopodium album* and *Amaranthus retroflexus*.

The female lays her eggs in a regular row on the under surface of the leaves ; the incubation lasts about four days ; the larvae feed on the leaf tissue and leave only the veining intact. The larval period lasts from 15 to 17 days, the pupal state only from 14 to 20 days.

The only known parasite is *Opius foveolatus* Ashm. A 5,6 or 7 per cent solution of barium chloride has been successfully used as a means of destroying the pest.

(1) See also *B.* March 1913, No. 585, and *B.* Feb. 1913, No. 196

1151 — **_Dacus vertebratus_ (cucumber and vegetable marrow fly), a Dipteran which is Harmful to Cucurbitous Plants in South Africa.** — GUNN, D. in *Union of South Africa, Department of Agriculture, Division of Entomology*, No. 9, pp. 2-6, Pretoria, 1916.

Dacus vertebratus causes considerable damage to the cucumbers, pumpkins, water melons and in general to all the Cucurbitous plants that are cultivated in South Africa. The female lays her eggs, 10 to 25 at the same time, in the rind of the fruit: the incubation period is from 2 to 5 days. The larvae bore long galleries in the rind, which grows soft and shrivels up, they also bore in the pulp which becomes a semi-liquid mass with a rancid smell. The larvae when they are mature crawl into the ground where they pupate. The adults come out after 5 or 7 days and live from 1 to 5 months.

It is advisable as a means of control to spread over the plants in need of protection sweet substances (sugar etc.) of which the insect is very fond, mixed with poison. The following formulae have been successfully employed:

1) Lead arseniate (in a paste)	3	oz.
Molasses	2	lbs.
Water	2	gallons.
2) Lead arseniate (in a paste)	3	oz.
Molasses	2	lbs.
Glycerine	3	oz.
Water	2	gallons.
3) Lead arsenate (in a paste)	2	oz.
Sugar	2½	lbs.
Water	2	gallons.

When the weather is warm and dry the applications must be made every 10 to 14 days. But if the weather is wet they should be renewed as often as possible immediately after the rain.

Coleoptera Harmful to Fruit and to Flowering Plants Cultivated in South Africa. — GUNN, D. in *Union of South Africa Department of Agriculture, Division of Entomology*, No. 8, pp. 1-6, 1 pl. Pretoria, 1916.

In South Africa in the summer several *Coleoptera* cause serious damage to fruit trees and flowers in the orchards and gardens. Their favourite host is the peach tree, whose harvest they spoil to the extent of about 50 per cent. by attacking the ripe and the ripening fruit. Among other hosts are rose trees, dahlias, pears, plums, nectarines, apricots, oranges (buds) and vines (leaves).

The species most often observed in the neighbourhood of Pretoria during the period 1913 to 1914 were the following: *Rhabdotis antica*, *Pachnoda impressa*, *P. cincta*, *P. carmelita*, *Heterorrhina flavomaculata*, *Plaesthina recurva* var. *plana*, *Oxythyrea marginata* and *O. dysenterica*.

As a method of control the direct capture of the adults is advised; this is effected by means of special butterfly nets fastened to the ends of canes which can be used easily even by the natives.

1153 – ***Philagathes laetus* a Coleopteran Pest on the Peach Tree in South Africa.** — GUNN, D. in *Union of South Africa, Department of Agriculture, Division of Entomology*, No. 8, pp. 7-8, 1 Fig. Pretoria, 1916.

Philagathes laetus is for the first time recorded as harmful to peach trees in South Africa.

The adult attacks the ripe or ripening fruits causing lesions of varying extent. It may easily be caught by means of a butterfly net.

1154 – **The Plum Slug Caterpillar (*Parasa latistriga*), a Lepidopteran Pest on various Trees in South Africa.** — GUNN, D. in *Union of South Africa, Department of Agriculture Division of Entomology*, No. 7, pp. 1-7, 1 Pl. Pretoria, 1916.

This insect, which is widely distributed throughout South Africa, attacks apple trees, peachs, plums, nectarines, and oaks in the neighbourhood of Pretoria, and it is certain that further work will increase the list of its plant hosts.

The whole life-cycle of *Parasa latistriga* is completed in 93 days in the case of the first generation, and in 270 days in the case of the second. The eggs are laid in groups on the under surface of the leaves. The larvae which hatch out of them feed on the leaves and leave nothing but the veining; they then separate and emigrate to all parts of the plant.

Among the parasites of this insect are some of the *Hymenoptera* belonging to the family *Chrysididae*, whose action is very restricted. Effective preventive measures to be adopted against these larvae are application of lead arseniate in a paste or copper arsenio-acetate mixed with lime.

1155 – **Concerning the Fruit Fly (*Ceratitis capitata*), in Tunis** (1). — GUILLOCHON, J. in *Comptes Rendus des Séances de l'Académie d'Agriculture de France*, Vol. II, No. 16, pp. 473-477. Paris, 1916.

The writer gives an account of observations which he made in the Tunis Experimental Garden on *Ceratitis capitata* (the Mediterranean fruit fly of the Americans). The first mention of this fly dates back to 1898; the account given shows that the damage occasioned by the insect was confined to slow ripening peaches, which points to the conclusion that *Ceratitis* in the pupal state only develops after hibernation, at an average temperature of 20 C° higher than that required for the ripening of early varieties of American peaches.

The immunity is not however entirely a question of varieties, as matter of fact the early varieties that ripened late owing to transplantati were attacked like the late varieties.

The amount of damage done increased, and in July and August the wr er recorded the presence of larvae on peaches, apricots, kakis and alberi in August, September and October on pears and apples, and finally in D cember and January on oranges more especially on mandarins.

Henneguy's plan of sticking a certain number of fruits on to each tr with honey to act as traps, was followed without success, as was Trabut' of making traps with a solution of colophony in alcohol with the additio castor oil. The writer then decided to have the fallen fruit picked up ever

(1) See also *B.* May 1916, No. 604.

day and even to shake the trees in order to bring down the infected fruit and to burn it all.

In 1910 a few specimens of *Ceratitis* were reared in entomological boxes and it was observed that the mature larvae free themselves from the opening of the fruit and bury themselves (August 19). Ten days later (August 29) five perfect insects 2 males and 3 females were winged; the next day (August 30) there were 2 new females. An almost ripe peach which was placed in the box caused great agitation: the flies went backwards and forwards, on August 31 the females crawled over the fruit, by the first of September 2 of them were dead, and 3 others on the second. Experiments made by rearing them on pears and apples gave the same results, with a rather longer incubation period (21 days instead of 10).

On the growing fruit the larvae collect in the part of the mesocarp next to the stone, and in fruits like oranges in the spaces next to the seeds. In autumn when the temperature falls, *Ceratitis* pupates, and passes the winter in the pupa at the foot of the tree a little way below the surface of the ground.

The insect is dangerous in so far as it adapts itself readily to different climates; it is recorded from the West Indies, which should be its original home, in the Islands of Hawai, in Oceania, in the regions around the Mediterranean, and in certain comparatively hot summers, in the neighbourhood of Paris (1). It lives at the expense of fruits which are far removed from one another and which ripen at very different times.

BACK and PEMBERTON of the United States Department of Agriculture record as parasites of the *Ceratitis* introduced by SILVESTRI: *Galesus silvestrii, Dirhinus giffardii, Opius humilis; Syntomosphyrum indicum* has also been recorded (2).

INJURIOUS VERTEBRATES.

1136 **Cottontail Rabbits (*Sylvilagus* spp.) in the United States.** — LANTZ, D. E. in *United States Department of Agriculture. Farmer's Bulletin* No. 702, pp. 1-12. Fig. 1-5. Washington, D. C., 1916.

Over a great part of the United States cottontail rabbits (Gen. *Sylvilagus*) cause more or less extensive damage in cultivated land, especially during the winter, when their ordinary pastures are covered with snow and they are driven to attacking trees (especially apples) by gnawing them and tearing off the bark; in this way they are often responsible for the death of fruit trees.

The bulletin in question contains instructions for combating this pest, legal regulations regarding hunting in the various States, formulae for the preparation of poisoned baits, and descriptions of two traps (Welhouse and Walmsley) used successfully for catching these rodents.

(1) See also *B.* Sept. 1915, N. 993.
(2) See also *B.* Feb. 1914, No. 190. (*Ed.*).

ALFREDO RUGGERI, *gerente responsabile*